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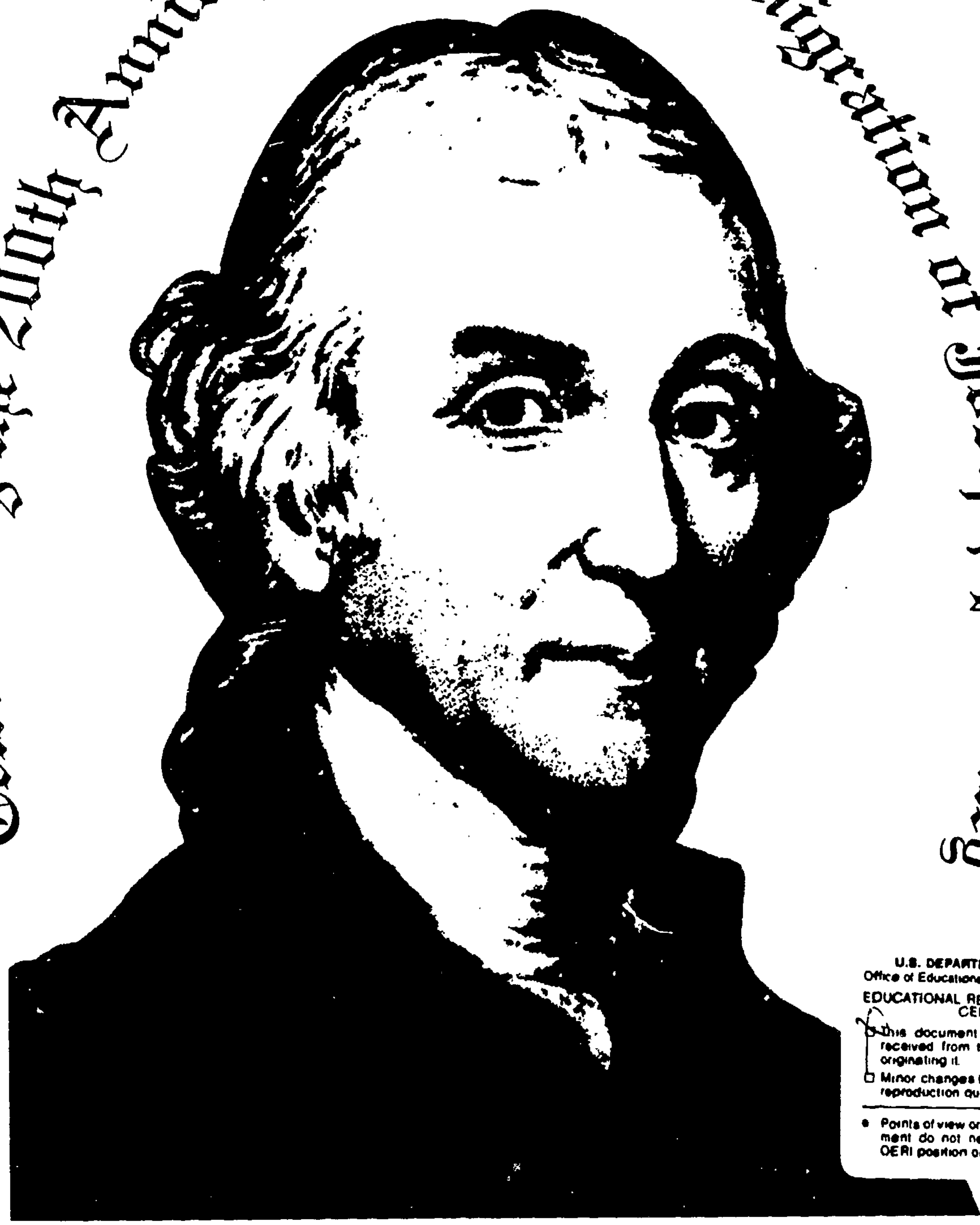
IDENTIFIERS Environmental Chemistry

ABSTRACT

Included in this proceedings are: (1) letters to conferees; (2) conference chairpersons; (3) symposia listing; (4) chemical demonstrations, listing and abstracts; (5) "birds-of-a-feather" sessions, listing and abstracts (informal sessions providing an opportunities for people with similar interests to meet); (6) workshop listings; (7) symposia abstracts; (8) workshop abstracts; (9) authors index; (10) exhibitors; and (11) daily "at-a-glance" summaries. The majority of abstracts are represented by the following symposia topics: chemical research opportunities for secondary school faculty; overview of computer use in chemical education, high school and general chemistry; increasing the use of writing in chemistry courses; a single coherent picture of the chemical bond; technicians and technician education; what will "textbook" mean in the year 2000?; environmental chemistry and environmental science programs; changing the teaching of chemistry at large universities; the non-traditional student; teaching favorite topics; laboratory teaching; undergraduate research; computer applications in the classroom and laboratory; new approaches to teaching organic chemistry; how will national initiatives in science education affect the teaching of high school and college chemistry?; innovative uses of modern instrumentation in introductory chemistry courses; research in education; teacher education and the high school curriculum; and transforming the chemistry learning environment. (LZ)

Celebrating the 200th Anniversary of the Emigration of Joseph Priestley



13th BCCE BUCKNELL UNIVERSITY

Abstracts and Program for the
13th Biennial Conference on Chemical Education
July 31-August 4, 1994

Sponsored by the Division of Chemical Education
of the American Chemical Society

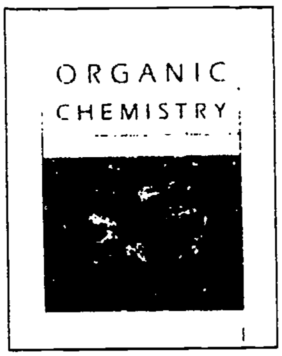
InnovationApplicationCombination

New for 1995

CHEMICAL PRINCIPLES, Second Edition

Steven S. Zumdahl, University of Illinois
1995 Hardcover 1120 pages est.

Designed specifically for the needs of more rigorous general chemistry or honors courses, this second edition exposes students to the essential concepts in chemistry while covering advanced topics in gases, atomic theory, kinetics, equilibrium, and thermodynamics. Explaining the reasoning that underlies important chemical principles, the text helps students to actually think like chemists and enables them to understand the scope of chemistry. Its level of mathematical sophistication is aimed at challenging those students having strong calculation skills and high ability. In addition, to demonstrate the importance of chemistry in real life, a number of applications and recent advances in chemistry have been incorporated throughout the book.



ORGANIC CHEMISTRY: Structure and Reactivity, Third Edition

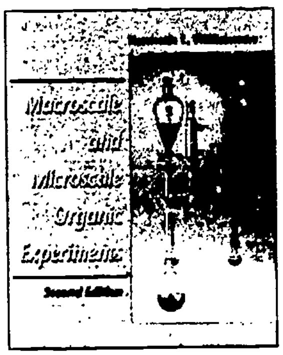
Seyhan Ege, University of Michigan
1994 Hardcover 1355 pages

The Third Edition of ***Organic Chemistry: Structure and Reactivity*** continues to emphasize an understanding of the basis of chemical reactivity. Through an innovative, thorough, and consistent mechanistic approach, the text creates a foundation on which students can build their own analytical skills. Ege encourages students to think about chemical reactivity and to predict reaction products following the lines of reasoning used by organic chemists.

APPLIED CHEMISTRY, Third Edition

William R. Stine, Wilkes University
1994 Paper 600 pages

This outstanding choice for liberal-arts chemistry courses is now available from D. C. Heath in its Third Edition. In this lively, affordable text, more than two-thirds of the 26 chapters are devoted to applications drawn from a variety of timely subjects. The chemical principles related to these applications are introduced as students need to know them, avoiding the dry, encyclopedic presentation that often plagues texts at this level.



MACROSCALE AND MICROSCALE ORGANIC EXPERIMENTS, Second Edition

Kenneth L. Williamson, Mount Holyoke College
1994 Hardcover 765 pages

This Second Edition laboratory text maintains its pioneering combination of both macroscale and microscale experiments with an emphasis on safety and waste disposal. The text's proven experiments include unique "Cleaning Up" features at the end of every activity that teach students how to convert hazardous materials to less hazardous or even innocuous waste, minimizing both the quantities of waste produced and the costs of disposal.

Also Available

CHEMICAL EXPLORATIONS

Jerry Bell, American Association for the Advancement of Science
1993 Paper 403 pages

GENERAL CHEMISTRY, Ninth Edition

1991 Hardcover 1007 pages

GENERAL CHEMISTRY WITH QUALITATIVE ANALYSIS, Ninth Edition

1991 Hardcover 1098 pages
Henry F. Holtzclaw, Jr., University of Nebraska—Lincoln
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CHEMISTRY: Concepts and Models

William R. Robinson, Purdue University
Jerome D. Odom, University of South Carolina
Henry F. Holtzclaw, Jr., University of Nebraska—Lincoln
1992 Hardcover 753 pages

Dedication

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13th Biennial Confe_ence on Chemical Education
July 31 - August 4, 1994
Bucknell University

Program and Abstracts

Exhibits

Will be on the second floor of the Langone Center.

Show hours are:
Monday 10 AM - 6 PM
Tuesday 10 AM - 6 PM
Wednesday 9 AM - 4 PM

We wish to express our sincere gratitude to the sponsors of our plenary speakers: ARCO Chemical Company, The Merck Company Foundation, and the Susquehanna Valley Section of the ACS.

We also thank Cellular One of Winfield, Pennsylvania for the loan of cellular phones during this conference.

The 2YC3 Committee wishes to thank the sponsors of the Monday evening receptions: Chemical Education Resources, Falcon Software, Inc. Houghton Mifflin Company and McGraw-Hill, Inc.

Division of Chemical Education, Inc.
AMERICAN CHEMICAL SOCIETY

August 1994

Dear Colleague:

On behalf of the Division of Chemical Education, I welcome you to our 13th Biennial Conference on Chemical Education. The Biennials are a major part of the life of the division, and rank as some of the most stimulating and exciting gatherings of chemistry educators I know. I extend a special welcome to those of you who are attending for the first time. If you are not yet a member of the Division, I hope this meeting encourages you to join and continue networking with us.

You have a busy and thought-provoking week ahead. The program is extensive and will make you wish you could be in several places at once. Not all the benefits of the Biennial occur in the technical sessions. The colleagues you meet over dinner and those you trade ideas with well into the night will inspire you, commiserate with you, pique your imagination, and send you home with a fresh perspective.

I wish to extend the Division's hearty thanks to both Margaret Kastner, our General Chairman, and Patricial Samuel, our Program Chairman, for their herculean efforts in organizing this meeting.

Sincerely,

Adrienne W. Kozlowski

Adrienne W. Kozlowski
Chairman, Division of Chemical Education

2YC3
TWO YEAR COLLEGE CHEMISTRY CONFERENCE
DIVISION OF CHEMICAL EDUCATION
AMERICAN CHEMICAL SOCIETY

Florida Community College at Jacksonville
Kent Campus
3939 Roosevelt Blvd.
Jacksonville, FL 32205
(904) 381-3400

Wendell Massey
1994 Chair
Committee on Chemistry
in the Two-Year College

Dear 13th Biennial Participants:

On behalf of the Committee on Chemistry in the Two-Year College, Division of Chemical Education, I would like to welcome you to this conference. I am glad that you came and feel sure that you will obtain valuable information that will enhance the chemistry program at your respective schools.

If you are a two-year college chemistry teacher I especially would like to encourage you to visit the 2YC, booth where you will find information pertaining to the Two-Year College Chemistry Conferences held every year. Even if you are not a two-year college teacher, you will find useful information about our organization. Many four-year college and high school teachers attend our conferences.

I hope you have a profitable and enjoyable experience this week.

Sincerely,

Wendell A Massey

Wendell Massey

August, 1994

Dear Colleague;

The members of the Pennsylvania Association of College Chemistry Teachers, PACCT, would like to welcome you to the 13th Biennial Conference on Chemical Education.

Every spring our membership meets for a two-day mini conference that features a keynote speaker and talks by the PACCT membership. Submitted papers cover original research in all the traditional areas of chemistry, with particular emphasis on research in an undergraduate environment and topics in the area of chemical education.

If you would like to know more about our organization or wish to share information about similar state organizations , please attend our PACCT luncheon scheduled for 12:00 on Thursday, August 4th.

Sincerely,

PACCT Members,

Tom Russo
Penn State, Altoona

Sally Solomon
Drexel University, Philadelphia

Borough of Lewisburg

331 Market Street Lewisburg, Pennsylvania 17837-1497 (717) 523-3614

July 31, 1994

Educators of Chemistry
13th Biennial Conference on
Chemical Education
Bucknell University
Lewisburg, PA 17837

Re: Welcome to Lewisburg

Dear Educators:

On Behalf of the people of Lewisburg I welcome you to Bucknell and Lewisburg. Please take this opportunity to enjoy Bucknell and our community with its many highlights and historic features. I hope that your visit with us will be enriching and memorable.

You will find that downtown Lewisburg and the Lewisburg Historic District are within walking distance from campus. I am sure that your busy schedules will allow you to visit our merchants and experience the historic charm of Lewisburg.

Information and maps of Lewisburg are available on campus and from our Chamber of Commerce at 418 Market Street. Enjoy your visit and please come back and visit with us again very soon.

Sincerely,

Michael M. Molesevich
Mayor

NOTE:
Emergency - Call 911
Chamber Office 524-2815

Emergency on campus - Call 1111

GENERAL CHAIR:

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Bucknell University
Lewisburg, PA 17837

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Joyce Miller and D. Eric Bliss

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Lewisburg, PA 17837

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Lock Haven University
Lock Haven, PA 17745

CONFERENCE REPORTER:

Bruce Wilcox
Department of Chemistry
Bloomsburg University
Bloomsburg, PA 17815

IN-SERVICE COORDINATOR

David Franz
Department of Chemistry
Lycoming College
Williamsport, PA 17701

Symposia

Sunday Evening

7:30 P - 1 Keynote Address
Weis Center
Hard Choices and Tested Options: The Historical Examples and Hands-on Experiments in ACS's New Smithsonian Exhibit. N. D. Heindel

Monday Morning

8:00 P - 2 Plenary Address
Weis Center
Joseph Priestley Comes to America. D. A. Davenport

Of Mice and Men and the Isolation of Oxygen
Weis Center
A. T. Schwartz, Organizer and Presiding
9:15 Introductory Remarks
9:30 1 - 1 The Chemistry of an "Honest Heretic". A. T. Schwartz
10:00 1 - 2 Priestley and Franklin: An Electrical Dialogue. D. J. Rhees
10:30 1 - 3 'The Same Summer, and the Same Sun': Priestley, Ingenhousz and the Elucidation of Photosynthesis, 1771-1787. J. L. Sturchio
11:00 1 - 4 Factitious Airs and Fractious Discoveries. W. B. Jensen

Chemical Research Opportunities for Secondary School Faculty
Coleman 101B
S. Van Natta, R. French, Organizers and Presiding
9:30 Introductory remarks.
9:40 4A - 1 Industrial Research and Development Summer Internship Program for Science Teachers. R. J. Sunberg, T. J. Logan
10:10 4A - 2 Reality Based Education: Partners for Terrific Science's Industrial Internship Program. S. Van Natta, R. French
10:40 Discussion
10:50 4A - 3 The U.S.Department of Energy's Teacher Research Associates (TRAC) Program. J. Melcher
11:20 4A - 4 Project Gemma: A Summer Mentorship Program for the Improvement of Secondary Math and Science Education. H. L. Paige, A. M. Farrell, S. F. Rinehart

Overview of Computer Use in Chemical Education: High School and General Chemistry
Rooke Chemistry Auditorium, Room 116
D. Rosenthal, Organizer and Presiding
9:30 17A - 1 Visualizing Atoms and Molecules in High School. B. E. Rowe
10:00 17A - 2 Integrating Computers into the High School Chemistry Classroom. W. J. Sondgerath
10:30 Discussion
10:45 17A - 3 Using Interactive Molecular Visualization and Multimedia Courseware to Teach General Chemistry. L. L. Jones, C. L. Fields
11:15 17A - 4 Computers in Chemistry at Wisconsin. J. W. Moore
11:45 Discussion

Increasing the Use of Writing in Chemistry Courses
Coleman Theater
H. Beall, Organizer and Presiding
9:30 38A - 1 Recent Growth of Writing in Chemistry Teaching. H. Beall
10:05 38A - 2 Writing in Chemistry Courses. G. F. Atkinson
10:40 38A - 3 Writing in the Undergraduate Laboratory. R. A. Bailey
11:15 38A - 4 Using Writing to Foster Intellectual Growth. D. C. Finster

Teaching My Favorite Topic
Vaughan Lit. Auditorium
E. Pulliam, R. Perkins, F. Cardulla, Organizers and Presiding
9:30 41A - 1 Qualitative Reaction Kinetics. K. J. Spengler
9:55 41A - 2 Synthesis of a Key Intermediate in the Origins of Life: HCN. R. Navarro-Gonzalez, S. Castillo-Rojas, E. Marambio-Dennett
10:20 41A - 3 Sparking the Imagination with Electrochemistry. J. L. Ealy, Jr.
10:45 41A - 4 Ancient Riddles, Modern Methods: Using Archaeology in Teaching Chemistry. A. E. Sheffield
11:10 41A - 5 Modeling Organic Compounds. P. T. Hayes
11:35 41A - 6 Transition Element Chemistry. C. Chambers

Can We Have a Single Coherent Picture of the Chemical Bond?
Forum, Langone Center 272
H. B. Thompson, Organizer and Presiding
9:30 Introductory remarks.
9:40 42A - 1 The Electron Domain Model: An Alternative Approach to the Chemical Bond for General Chemistry. R. J. Gillespie
10:10 42A - 2 The Charming and Useful Unreality of Molecular Orbitals. H. B. Thompson
10:40 42A - 3 Models of Chemical Bonding. J. F. Harrison
11:10 42A - 4 Electron Density Models of Molecular Structure. G. P. Shusterman, A. J. Shusterman

Technicians and Technician Education: Becoming Mainstream?
Gardner Auditorium, Dana 132
K. Chapman, Organizer and Presiding
9:30 Introductory remarks.
9:35 54 - 1 Corporate Expectations of Laboratory Technicians and Plant Operators in the New Chemical Industry. P. Jackson
9:55 54 - 2 An Industry Response to Training the Needs of Chemical Plant Operators. J. Bush
10:15 54 - 3 A Technician's Career in a Changing Chemical Industry. A. Vecere
10:35 54 - 4 Professionalism, A Chemical Technician's Trademark. R. Kellum
10:55 54 - 5 A Tentative Response to Standards, Individual Career Aspirations, and Chemical Industry Needs. K. Chapman

Monday Afternoon

Chemical Research Opportunities for Secondary School Faculty
Coleman 101B
S. Van Natta, R. French, Organizers and Presiding
1:30 4B - 1 BP Oil/BP Chemicals Teacher in Residence Program. J. E. Gilbert
1:50 4B - 2 Partners in Science. M. L. Grayeski
2:10 4B - 3 Research Internships for K-12 Teachers: What Makes for Success? What is Success?. S. K. Henderson
2:30 Discussion
2:40 4B - 4 The Master of Arts Degree - Opportunities for High School Teachers. G. M. Rehberg
3:00 4B - 5 The Los Alamos National Laboratory Appointment, DOE/TRAC. M. Reluga
3:20 4B - 6 ...And "What did you do During Your Summer Vacation, Gwen?". M. G. Sibert

Overview of Computer Use in Chemical Education: Organic & Analytical Courses
Forum, Langone Center 272
D. Rosenthal, Organizer and Presiding
1:30 17B - 1 Computational Chemistry as a Key Tool to Teach Organic Chemistry. J. Casanova
2:00 17B - 2 Self-Paced Organic Chemistry. S. Smith
2:30 Discussion
2:45 17B - 3 Teaching Computer Skills, an Essential Tool for all Chemists. R. Megargle
3:15 17B - 4 New Curriculum Model Using Cooperative Learning and Computers in Analytical Chemistry Courses. J. C. Wright
3:45 Discussion

What Will "Textbook" Mean in the Year 2000?
Coleman 101A
R. Kerber, Organizer and Presiding
1:30 20 - 1 Adapting a Chemistry Textbook to Accompany a Modular Approach. D. R. Kimbrough
1:45 20 - 2 Is the Textbook Dead? J. C. Kotz
2:00 20 - 3 Student Expectations for Course Material in the Year 2000. R. C. Stratton
2:15 Discussion
2:30 20 - 4 Package or Perish: The Publisher's Challenge. K. P. Hamann
2:45 20 - 5 The Textbook of the Future. J. Speer
3:00 20 - 6 Publishing in the Twenty-first Century. The Role of New Technologies. N. Rose
3:15 Discussion
3:30 20 - 7 A New Approach to General Chemistry. A. M. Scanlan-Rohrer
3:45 20 - 8 Textbook and Technology: The Future of Chemical Education. C. W. Porter
4:00 20 - 9 Making Connections and Making Decisions: Interactive Multimedia Software as a Component of Future Chemistry Textbooks. T. J. Greenbowe
4:15 Discussion

Environmental Chemistry & Environmental Science Programs
Olin Auditorium Room 268
I. Hartman, L. Soltzberg, Organizer and Presiding

1:30 24 - 1 Aims of a Program in Environmental Science. I. S. Hartman
1:50 24 - 2 Environmental Science and Public Impact: Vassar's Approach. M. H. Begemann
2:10 24 - 3 Students Environmental Awareness and Their Understanding of Chemistry Relevant STES Issues. U. Zoller, Y. J. Dori, A. Lubezky
2:30 24 - 4 Environmental Studies Curricula. J. A. Gibbs, J. Flowers, H. Karan
2:50 Discussion
3:05 24 - 5 Marine Chemistry for Undergraduates. S. Libes
3:20 24 - 6 An Environmental Analysis Course for Undergraduates. C. L. Fish
3:35 24 - 7 Introduction of Environmental Experiments Throughout the Undergraduate Chemistry Curriculum. W. J. Stratton, J. Hansen
3:50 Discussion

Moving Mountains: Changing the Teaching of Chemistry at Large Universities
Coleman Theater
J. Keiser, Organizer and Presiding

1:30 26 - 1 The One Minute Paper: A Communication Tool for Large Classes. W. S. Harwood
1:50 26 - 2 Using Instantaneous Small Groups in Large Lectures: A First Step Towards a Collaborative Learning Environment. T. A. Holme
2:10 26 - 3 Moving Mountains One Rock at a Time: My Experiences in Changing General Chemistry. J. J. Fortman
2:30 26 - 4 A Revised General Chemistry Curriculum with an Emphasis on Modern Applications of Chemistry. P. M. Owens, R. G. Costella
2:50 26 - 5 The Language of Chemistry: Organic Chemistry, Case Studies, and Nonscience Majors. S. L. Bretz, J. Meinwald
3:10 Break
3:20 26 - 6 Changing the Teaching of Chemistry at a Megaversity. L. P. Gold, J. P. Lowe, R. D. Minard, J. T. Keiser, R. A. Henry, P. C. Jurs
3:40 26 - 7 The Continuity of Chemistry: A Demonstrative Curriculum. A. A. Hazari, J. D. Kovac, F. M. Schell, F. A. Grimm
4:00 26 - 8 The New Chemistry Curriculum at the University of Michigan. S. N. Ege, B. P. Coppola
4:20 26 - 9 Closing the Instructional Goals Gap: Providing New Metaphors for Faculty and Students. B. P. Coppola, J. W. Hovick, J. S. Krajcik
4:40 26 - 10 Replacing the One-Faculty/One Course Model of Reform: The Department-based Audit of Undergraduate Instruction. S. Tobias

Increasing the Use of Writing in Chemistry Courses
Coleman 103B
H. Beall, Organizer and Presiding

1:30 38B - 1 Writing Across the Curriculum: Linking Science and English. L. S. Zarzana
1:50 38B - 2 Writing Across the Curriculum and Freshman Chemistry. N. J. S. Peters, D. C. Cutts
2:10 38B - 3 Using Writing to Teach Science: Rescuing the Laboratory Report. J. A. Swan
2:30 Discussion
2:45 38B - 4 Chemistry and Societal Issues: A Writing Course for Non-science Majors. J. N. Cooper
3:05 38B - 5 Writing in a Large Non-science Introductory Chemistry Class. H. Hedgecock
3:25 38B - 6 Writing in Chemistry Courses for Nursing and Non-science Majors. C. V. Gauthier
3:45 Discussion

The Non-Traditional Student
Coleman 202A
H. Burke, M. Lee, Organizers and Presiding

1:30 40 - 1 General Chemistry at Xavier University of Louisiana. A. Privett
1:50 40 - 2 Filling the Pipeline: A Celebration of Diversity. N. Cox-Konopelski
2:10 40 - 3 A Profile of Students Taking a Distance Learning Course in Chemistry for Nonscience Majors. M. K. Schumm
2:30 40 - 4 19 Years of Non-traditional Students in the Access Evening Degree CH151/209 Consumer Science and CH140/211 Science of Enology (Winemaking) Courses at the Main and Satellite Campuses. F. J. Gadek
2:50 40 - 5 Encouraging Success in General Chemistry for the Working Student. G. K. Vick, L. ElNagger, M. P. Lee
3:10 Discussion

Teaching My Favorite Topic
Vaughan Lit. Auditorium
E. Pulliam, R. Perkins, F. Cardulla, Organizers and Presiding

1:30 41B - 1 My Favorite Topic: Cruising on Chemical Equations. S. Berman-Robinson
1:55 41B - 2 Chemistry and Crime: An Introduction to Forensic Science. L. J. Kaplan
2:20 41B - 3 The Miraculous Chemistry of Oxygen. J. M. DeKorte
2:45 41B - 4 Quantum Mechanics - My Favorite Topic. C. C. Groves
3:10 41B - 5 Solutions--A Favorite Unit of My Students. M. R. Walsh
3:35 41B - 6 Using Far Sides in the Chemistry Classroom. L. F. Brough

Can We Have a Single Coherent Picture of the Chemical Bond?
Gardner Hall, Dana 132
H. B. Thompson, Organizer and Presiding

1:30 42B - 1 A History of the Van Arkel Bond-type Triangle. W. B. Jensen
2:20 42B - 2 Bond Type Determined by Two Electronegativity Functions. G. D. Sproul
3:00 42B - 3 Chemical Bonding Without Quantum Mystery. J. P. Ranck
3:30 42B - 4 A Unifying Model for Atomic, Molecular Orbital, Valence Bond-hybridization and VSEPR Theories. H. J. Teague
4:00 42B - 5 A Simple, Reliable Model for Predicting Structures and Properties: Coulombic Models as an Alternative to Electronegativity. L. J. Sacks

Conversation: Is the ACS Approved Curriculum Outdated?
Coleman 102A
M. Kenney, Organizer and Presiding

1:30 46 - 1 The ACS Curriculum for Chemistry Majors: Is It Outdated? G. A. Crosby
1:40 46 - 2 ACS-CPT Guidelines and Curricular Reform. J. R. Mohrig
1:50 46 - 3 Recent Evolution of the ACS Approved Curriculum for Chemistry Majors. G. A. Hamilton
2:00 46 - 4 The ACS Committee on Professional Training: Quis Custodiet Ipsos Custodies? G. M. Bodner
2:10 46 - 5 Outline for a New Curriculum. E. Wildi
2:20-4:00 Discussion

Laboratory Teaching
Coleman 1A
P. L. Samuel, Organizer; C. A. Baker, Presiding

1:30 57A - 1 Who's Lab is it Anyway? C. A. Baker
1:50 57A - 2 Instrumentation in the High School Chemistry Classroom--FTIR M. R. Walsh
2:10 Discussion
2:20 57A - 3 Student Design of Projects for Freshman Chemistry. Z. K. Barnes, D. Adsmond
2:40 57A - 4 Student Designed Experiments in First Year College Chemistry. T. Hoyt
3:00 Discussion
3:10 57A - 5 The Timing of Organic Lab: The Ultimate Organic Chemistry Experiment. A. E. Moody, K. A. Foster
3:30 57A - 6 Gulliver's Travels in Organic Chemistry: A Compact, Comprehensive Organic Chemistry Laboratory Experience. R. L. Wilde
3:50 Discussion

Chemical Demonstrations
Weis Center
P. L. Samuel, Organizer; M. Freilich, Presiding

4:15 60 - 1 To Planet Earth with Love from Chemistry. A. Hubbard
4:45 60 - 2 Polymer and Plastic Chemicstry Demonstrations. V. Wilcox

Monday Evening

Poster Sessions

Posters: Learning Chemistry by Doing Chemistry: Undergraduate Research
Rooke Chemistry Attrium, All 3 Floors
J. Panek, Organizer and Presiding

7:30 3 - 1 Characterization of a Quantitative Colorimetric Assay for use in the Study of L-Azetidine-2-Carboxlyic Acid Metabolism: An Undergraduate Research Project. C. L. Bering, N. M. Beck, R. Bose
3 - 2 Electrodeposition of Copper on Conductive Polymer Films Studied by the EQCM Technique. Y. Chen, M. Hepel
3 - 3 Synthesis and Spectral Characterization of Potentially Solvatochromic Fluorophores. J. Rutherford, G. M. Rehberg, B. W. Williams

3 - 4 Environmental Photochemistry: The Photolysis of Aqueous Solutions of Aromatic Organomercury Compounds. D. Stewart, T. Dowd, M. DeTar, S. Lew, M. Pietrzykowski, N. Zevos

3 - 5 Vanadium(V)-facilitated Hydrolysis of Bis(Salicylidene) Ethylenediimine. R. L. Fisher, C. A. Root

3 - 6 Graham's Law Revisited - Why a Simple Classroom Demonstration Gives Inconsistent Results. J. R. Blackburn, M. H. Wilson

3 - 7 Research at the Undergraduate - Industrial Interface. P. E. Beck

3 - 8 The Role of Undergraduate Research in a New Chemistry Major at a Small College. M. G. Chisholm, A. J. Jircitano

3 - 9 Ternary Zintl Phases as Precursors for III-V Semiconductor Materials. T. T. Birdwhistell, T. Jeffries, C. Klein, B. Koplitz, P. Barnes, D. Dennison, K. Dillon

3 - 10 A Novel Approach to Optically Active Cycloalkenones. A. A. Ross, T. T. Shawe, P. M. Robinson, A. Cannon, A. Prokopowicz

3 - 11 Iterative Reductive Alkylation Approach to Alkaloids. J. P. Fulmer, T. T. Shawe, C. J. Sheils, S. M. Gray

3 - 12 Use of Cyclic 1-Azadienes in Diels-Alder Reactions. B. M. Glass, G. M. Rehberg

3 - 13 Use of Cyclic 1-Azadienes in Diels-Alder Reactions. J. M. Nelson, G. M. Rehberg

3 - 14 Polymer Electrolyte Materials with Molecular Level Protective Coatings. D. Teeters, K. Cleavelin, C. Bauerly

Posters: Computer Applications in the Classroom & Laboratory
Rooke Chemistry 17 IBM Lab, Rooke Chemistry 9 Mac Lab. and other basement space
G. Sibert, P. Samuel, Organizers and Presiding

7:30 15A - 1 Withdrawn

15A - 2 CUPLE-ing Chemistry and Physics. R. L. Hartshorn, P. H. Davis

15A - 3 CURVYARO: An Interactive Computer Instructional Workbook for Lewis Valence Bond Structures and Electron Bookkeeping. T. D. Walsh

15A - 4 Reporting Results with Computers: Laboratory Report Writing with Word, Excel and Superpaint. J. W. Henderson

15A - 5 Automatically Graded Personalized Homework for Freshman Chemistry. J. D. Spain

15A - 6 Stoichiometry and Economy-A Cost Minimization Analysis Experiment. E. A. Mottel, H. L. McLean

15A - 7 Macintosh Computers in Organic Chemistry Lecture and Lab. D.E. Marko, J.Z. Gillies, E.W. Wolpaw

15A - 8 A Mathematica Program for Solving the Schroedinger Equation. J. C. Hansen

Posters: Cultivating Problem Solving in the Undergraduate Organic Laboratory
Larison Dining Hall
E. Harrison, Organizer and Presiding

7:30 34 - 1 Gray Matter in the Organic Chemistry Lab. The "Mystery Reaction" as a Vehicle for Enhancing Thinking and Learning. N. E. Carpenter, L. Lentsch

34 - 2 Development of a Problem Solving Laboratory for Organic Chemistry. J. H. Cooley

34 - 3 Using the Pinacol Rearrangement to Teach Technique, Structure Determination, and Mechanisms. B. J. Wojciechowski

34 - 4 Puzzle Solving in the Organic Lab Using NMR Spectroscopy. A. T. Rowland

34 - 5 Cultivating Problem-solving and Collaborative Learning in the Undergraduate Organic Laboratory. The Synthetic Sequence Approach. E. A. Harrison

34 - 6 A Schiff Base Puzzle for the Organic Chemistry Laboratory. D. Todd

34 - 7 An Acetylene Identification Puzzle Experiment for the Organic Chemistry Laboratory. D. Todd

Posters: Is There an Ideal Periodic Table?
Rooke Chemistry 1st Floor Attrium
G. Gorin, Organizer and Presiding

7:30 44 - 1 The Knight's Move in the Periodic Table. M. Laing

44 - 2 A Periodic Table from a Different Set of Rules. R. S. Treptow

44 - 3 The (Nearly) Ideal Periodic Table. G. Gorin, A. Ratcliffe

Posters: Laboratory Teaching
Larison Dining Hall
P. L. Samuel, Organizer; A. Martin, Presiding

7:30 58A - 1 A Cooperative Group Laboratory Investigation. H. P. Williams, H. F. Woodruff

58A - 2 Updating the Classical Chemistry Laboratory. R. W. Kluiber

58A - 3 Chem Matters: Labs with Stories. D. Robson, M. Olenick

58A - 4 Fourth and Fifth Graders as Chemists. J. C. Beckman, W. A. Morrison

58A - 5 A Low-cost, Centigram Balance that Students Can Build. J. H. Bedenbaugh, D. L. Tyrone, A. O. Bedenbaugh

58A - 6 Increasing the Accuracy of Titrations Performed with Beral Pipets. J. H. Bedenbaugh, A. O. Bedenbaugh, A. P. Gunn

58A - 7 Microscopes in General Chemistry Laboratories. R. B. Gayhart

58A - 8 Improvements in the Quantitative Assay of Nonrefractory Minerals for FE(II) and Total FE Using 1,10-Phenanthroline. J. C. Templeton, J. R. Nelson, J. E. Amonette

58A - 9 Simple Demonstration of Lightning-induced Synthesis of NOx in the Atmosphere. S. Castillo-Rojas, R. Navarro-Gonzalez

58A - 10 An Eye-opening Experience: The Catalytic Decomposition of Hydrogen Peroxide. B. R. Flynn

58A - 11 A Series of Random Reactions. A. J. Lata

58A - 12 The Common Ion Effect: A Small Scale Approach. M. Azar, J. T. Keiser

58A - 13 Data Processing in Physical Chemistry Laboratories. J. N. Cooper

58A - 14 A Computational Elaboration on a Classic Physical Laboratory Experiment: The Semi-Empirical Determination of Delta-pKa and Substituent Effects. J. M. Lo Bue, R. W. Bell, M. R. Maxwell

58A - 15 Analysis of the Ethylacetate Hydrolysis System: A Glimpse at Least Squares in a Non-Linear Complex. J. M. Lo Bue, R. N. Nelson

58A - 16 Micro Chemistry in Brazil. R. Cruz

58A - 17 Laboratory Competitions and Student Involvement. W. E. Adams

58A - 18 Macintosh Computers in Physical Chemistry Laboratory. J. Z. Gillies, E. W. Wolpaw

58A - 19 From Titration Data to Buffer Capacities: A Computer Experiment. G. A. White

58A - 20 The Silver Mirror Test Using Phenylhydroxylamine. W. Jianping

58A - 21 Metal Chlorides as Catalysts for the Synthesis of Phenolic Resins. W. Jianping

58A - 22 Group Electronegativity Calculations. W. Yong, W. Jianping

Posters: Teaching Organic Chemistry
Larison Dining Hall
P. L. Samuel, Organizer; G. M. Rehberg, Presiding

7:30 58B - 1 Using FT-IR to Follow Microscale Organic Reactions in Community College. J. Ems-Wilson

58B - 2 Using the "Demonstrations in Organic Chemistry" Videodisc in the Classroom. G. L. Trammell

58B - 3 Understanding Substituent Effects without Resonance. F. M Klein

58B - 4 Use of the Chemical Literature as an Organic Laboratory Exercise. A. C. Friedli, M. V. Stewart

58B - 5 Write an Autobiography of a Functional Group. J. Hoyle

58B - 6 Small Scale Organic Laboratory Methods Using Supported Reagents and Solid Phase Extraction. D. A. Nelson

58B - 7 The Isolation of Betulin from Birch Bark and its Rearrangement: A Sophomore Organic Chemistry Experiment. B. Chung, M. D. Bentley, B. Green

58B - 8 Kinetics Experiment for Undergraduate Organic Chemistry Laboratory. S. A. Steiner

58B - 9 Pheromone Synthesis and Bioassay: Applied Organic Chemistry at the Undergraduate Level. C. L. Wistrom

58B - 10 Student Handouts for the Mechanistic Organization of Reactions of Carbonyl Compounds with Nucleophiles. J. W. Henderson

58B - 11 Teaching Organic Chemistry with Team Learning and Case Studies. J. F. Bieron, F. J. Dinan

Chemical Demonstrations
Olin Auditorium 268
M. Freilich, Organizer and Presiding

7:00 60 - 3 Chemical Domino Demonstration II. M. D. Alexander

7:20 60 - 4 Chemical Demonstrations: Live and Videotaped. J. J. Fortman

8:00 60 - 5 Acids and Bases in Living Color H. Bassow

Tuesday Morning

8:00 P - 3 Plenary Address
Weis Center
The Role of Catalysis in Achieving Environmentally Sustainable Growth in the 21st Century. J. A. Cusumano

How Will National Initiatives in Science Education Affect the Teaching of High School & College Chemistry?
Langone Center, Gallery Theater, Room 301
B. Kolоseike, Organizer and Presiding

9:30 Introductory remarks.
9:35 8 - 1 AAAS Project 2061: A Chemist's Perspective. J. A. Bell
9:55 8 - 2 University Chemistry, National Science Education Standards and State Curricular Development. J. E. Bauman
10:15 8 - 3 Scope, Sequence, and Coordination of Secondary School Science. D. L. Gabel
10:35 8 - 4 Project Kaleid ope - What Works in Science Education. , Mohrig
10:55 8 - 5 The Council on Undergraduate Research. H. Veening
11:15 Panel Discussion

How Things Work: The Chemistry of Technological Devices
Coleman Theater
A. Ellis, Organizer and Presiding

9:30 18 - 1 The Remarkable Memory of Nickel-Titanium Alloys. L. A. Wright
9:55 18 - 2 Ferrofluids and Magnetic Smart Materials. D. R. Neu
10:20 18 - 3 Piezoelectric Materials. G. E. Wnek
10:45 18 - 4 The Chemistry of High Temperature Superconductors. M. J. Geselbracht
11:10 18 - 5 The Chemistry of LED's and Laser Pointers. G. C. Lisensky
11:35 18 - 6 The Chemistry of Solar Cells and Portable Refrigerators. A. B. Ellis

Molecular Visualization: From the PC/Mac to the Workstation Environment
Weis Center
G. Bodner, Organizer and Presiding

9:30 Introductory remarks.
9:45 21A - 1 Computer Use and Misuse in the Classroom. J. Casanova, S. Casanova
10:20 21A - 2 Demonstrations, Molecular Modeling, and Common Sense. B. P. Coppola
10:45 21A - 3 PCmodel: Molecular Modeling Software for Personal Workstations. J. J. Gajewski, K. E. Gilbert
11:10 21A - 4 Computational Chemistry in the Undergraduate Curriculum. W. S. Mungall W. F. Polik
11:35 21A - 5 Combining Molecular Modeling and Spreadsheet Analysis - An Advanced Exercise in Physical Organic Chemistry. R. Hallford, G. Wright, T. W. Hanks

From the Chemistry of Responsible Environmentalism to Environmentally Responsible Chemistry
Forum, Langone Center
J. Cooper, Organizer and Presiding

9:30 23A - 1 Introducing Green Chemistry in Teaching and Research. T. J. Collins, S. W. Gordon-Wylie, R. E. Patterson, G. P. Wakeham
10:30 23A - 2 Environmental Chemistry in the Chemistry Curriculum. J. A. Swan, T. G. Spiro

TA Training: Solutions to Knotty Problems
Olin Auditorium, Room 268
S. Selfe, B. Barnes, Organizers and Presiding

9:30 27A - 1 A Teaching Assistant Training Course. W. Dasher, T. Hoyt
9:55 27A - 2 TA Training in the General Chemistry Laboratory Program at Penn State University. J. T. Keiser
10:20 Discussion
10:40 27A - 3 Teaching Assistant Training in Writing. S. T. Marcus, K. Hjortshoj
11:05 27A - 4 The Challenge of TA Training on a Shoestring: Two Concordia Projects. M. E. Baldwin
11:30 Discussion

Innovative Uses of Modern Instrumentation in Introductory Chemistry Courses
Vaughan Lit Auditorium
J. Steehler, Organizer and Presiding

9:30 31A - 1 An IR and MW Spectroscopy Experiment for the Beginning Laboratory. E. Koubek, W. Heuer
9:50 31A - 2 The Use of FTIR Spectroscopy for the Curricular Integration of General and Organic Chemistry. T. I. Spector
10:10 31A - 3 Organic Chemistry and Spectroscopy in General Chemistry. D. M. Whisnant
10:30 Discussion
10:45 31A - 4 Use of Advanced NMR Techniques in General and Organic Chemistry. V. R. Miller, J. Muzyka
11:05 31A - 5 A Computer-based Instrumentation System for Lower Division. J. R. Amend
11:25 31A - 6 Instructional Technology in a Freshman Honors Laboratory Course. E. D. Sprague
11:45 Discussion

Tuesday Afternoon

Van Programs: Instrumentation on the Road to High Schools
Coleman 1A
D. Mitchell, Organizer and Presiding

1:30 Panel I: Project Directors
6 - 1 A Comprehensive Science Outreach Program. D. J. Mitchell
6 - 2 Team Science: An Outreach. T. R. Boyette, R. Kirkley, A. J. Banks, D. G. Haase, J. C. Park
6 - 3 Teachers & Occidental = Partnership in Science. C. L. Craney, P. Hartvig, A. A. Mazzeo, T. Otsuki, G. Quimbita
2:30 - 4 Panel II: Participants

Molecular Visualization: From the PC/Mac to the Workstation Environment
Weis Center
G. Bodner, Organizer and Presiding

1:30 21B - 1 Research Level Computers and Software in the Undergraduate Curriculum. H. Jonsson
1:55 21B - 2 Computational Chemistry: A Course Utilizing PC's to Explore AB INITIO and Semi-empirical Calculation of Molecular Properties. M. E. Zandler
2:20 21B - 3 The Molecvue Project. J. P. Ranck
2:45 21B - 4 Enhancing the Visualization of an Industrial Process: Design and Evaluation. M. A. Workman, S. R. White, G. M. Bodner, R. G. Squires
3:10 21B - 5 Molecular Visualization and High School Students. S. McCarthy

From the Chemistry of Responsible Environmentalism to Environmentally Responsible Chemistry
Forum, Langone Center
J. Cooper, Organizer and Presiding

1:30 23B - 1 Successes & Techniques Associated with Teaching the Chemistry of Radioactive Waste. D. H. Williams
2:30 23B - 2 The Role of Atmospheric Nitrous Oxide. W. C. Trogler

Nurturing Chemistry Majors at Large Universities
Coleman 103B
L. Peck, Organizer and Presiding

1:30 28A - 1 Attracting and Nurturing Chemistry Majors at Texas A&M University. M. L. Peck, J. L. Hogg
1:50 28A - 2 Designing Chemistry Curriculum for Chemistry Majors at the University of Washington. D. H. Wiegand
2:10 28A - 3 Energy and the Environment: A Majors-Level General Chemistry Course. J. M. Farrar, R. Eisenberg, J. A. Kampmeier
2:30 Discussion
2:40 28A - 4 Use of an Aquatic Ecosystem in Undergraduate Analytical Chemistry Curricula. K. D. Hughes
3:00 28A - 5 Chemistry Major Letter Writing Project. J. R. Appling
3:20 28A - 6 Using the Materials Science "Companion": Putting Solids in the Foundation. A. B. Ellis
3:45 Discussion

Innovative Uses of Modern Instrumentation in Introductory Chemistry Courses
Vaughan Lit Auditorium
J. Steehler, Organizer and Presiding

1:30 31B - 1 Modern Introductory Laboratory. N. K. Kildahl, L. H. Berka
1:50 31B - 2 Modern Instrumentation in the Introductory Laboratory. L. R. Sharpe
2:10 31B - 3 Instrumentation in the Introductory Laboratory at Lebanon Valley College. R. D. Cornelius
2:30 31B - 4 Real Samples and Modern Instruments - A Pairing that Works. J. K. Steehler, V. R. Miller
3:00 Round Table Discussion

Increasing the Use of Writing in Chemistry Courses
Coleman Theater
H. Beall, Organizer and Presiding

1:30 38C - 1 Communication and Chemistry: A Stoichiometric Compound? J. E. White, B. E. White
1:50 38C - 2 Making Connections: Use of Student Journals in General Chemistry. A. G. McKenna
2:10 Discussion
2:20 38C - 3 Inter-disciplinary Writing in Analytical Chemistry. D. H. Fish, C. L. Fish
2:40 38C - 4 Writing Assignments for Teaching Quantum Chemistry. L. Comeford
3:00 38C - 5 A Scientific Writing/Communication Course for Chemistry Majors. E. W. Wolpaw
3:20 Discussion

New Approaches to Teaching Organic Chemistry
Langone Center, Gallery Theater, Room 301
R. Minard, Organizer and Presiding

1:30 48A - 1 Organic Chemistry as a Liberal Art. S. N. Ege, B. P. Coppola
1:55 48A - 2 New Wine in Old Bottles: A Decade of Strategies that have Helped Reveal the Value of Organic Chemistry to our Students. B. P. Coppola, S. N. Ege
2:20 48A - 3 The First Year Lab Component of the U of M Curriculum at Lock Haven University. R. W. Kleinman
2:45 48A - 4 Literature-based Course Work and Lab Work for Science-Motivated First-Year Students. J. W. Hovick, B. P. Coppola
3:10 Break
3:20 48A - 5 Grade/Performance Contract and Cooperative Learning Interventions in Undergraduate Organic Chemistry. R. C. Dougherty
3:45 48A - 6 The Organic Chemistry Lecture: What Happens When the Instructor Changes the Mode of Delivery?. R. C. Bauer, G. M. Bodner, K. A. Lowrey, G. M. Loudon
4:10 48A - 7 A Mechanism for Involving Organic Students in Their Own Learning. L. M. Sweeting
4:35 48A - 8 A Tour of the Revitalized Organic Lab Program at Penn State. R. D. Minard

Geochemistry in the Classroom
Coleman 101A
R.Jones, Organizer and Presiding

1:30 50 - 1 Geochemistry in General Chemistry. J. D. Hostettler
1:55 50 - 2 An Undergraduate Program for Training Environmental Technicians. S. M. Libes
2:20 50 - 3 Using Geochemistry to Pump up ACS Student Affiliate. R. B. Jones
2:45 50 - 4 Geochemistry for Chemists. J. D. Hostettler
3:10 50 - 5 A Graphical Solution to Aqueous Carbonate Equilibria. C. S. Kirby, M. A. Williamson, J. D. Rimstidt

What Is Chemical Education Research?
Olin Auditorium, Room 268
P. Metz, Organizer and Presiding

1:30 52 - 1 What is Chemistry Education Research? P. A. Metz
1:50 52 - 2 Unexpected Aspects of Quantitative Research. S. C. Nurrenbern, W. R. Robinson
2:10 52 - 3 Chemical Education Research Using Think-aloud Methods. C. W. Bowen
2:30 52 - 4 Qualitative Methodologies in Chemical Education Research: Challenging Comfortable Paradigms. A. J. Phelps
2:50 52 - 5 Overcoming the Sports Mentality: Action Research as a Metaphor for Curriculum Evaluation. G. M. Bodner, D. L. MacIsaac
3:10 Break
3:20 52 - 6 The Use of Surveys and Questionnaires in Chemistry Education Research. J. R. Pribyl
3:40 52 - 7 Chemical Education Research in the Laboratory Environment: How Can Research Uncover What Students Are Learning? M. B. Nakhleh
4:00 52 - 8 Research on Computers in Chemistry: A Short Primer. B. J. Hood
4:20 52 - 9 Chemical Education Research. J. D. Herron, D. Bunce, D. Gabel, L. Jones

Conversation: Coping with a Dual Assignment: Chemistry-Physics, -Biology, -Math
Vaughan 103
D. Slattery, Organizer and Presiding

1:30 7 - 1 Handling Multiple Teaching Assignments: One High School Teacher's Perspective. D. L. Slattery
1:40 7 - 2 Conversation on Handling Multiple Teaching Assignments. K. H. King
1:50 7 - 3 Science Education in the Small High School. B. Koloseike
2:00 7 - 4 Interdisciplinary Teaching. L V. Boer
2:10 - 4:00 Discussion

Teacher Education and the High School Curriculum
Coleman 202A
P. L. Samuel, Organizer; L. K. Lee, Presiding

1:30 57B - 1 A Model for Professional Development in a Chemistry Teacher Training Program. C. Wang
1:45 57B - 2 Sex and the Student Teacher. W. J. Gleekman
2:00 Discussion
2:10 57B - 3 Developing a State-wide Network of Chemistry Teachers. A. P. Zipp, R. J. Miller
2:25 57B - 4 In-service Instruction for Chemistry Teachers: A Unique Program in Mississippi. J. H. Bedenbaugh, A. O. Bedenbaugh
2:40 Discussion
2:50 57B - 5 CHEMCOM Cultivates Decision-Making Skills. R. J. M. Simmons
3:05 57B - 6 Salters' Advanced Chemistry: A Revolution in Pre-College Chemistry. D. W. Denby, N. Heeley
3:20 57B - 7 Filling the Pipeline: The Environmental Management Precollege Analytical Chemistry Program (EMPAC). J. A. Miller, T. G. Squires
3:35 57B - 8 A Naive Approach to Atomic and Ionic Radii. H. Bassow
3:50 Discussion

Teaching Tips
Gardner Auditorium, Dana 132
P. L. Samuel, Organizer; J. M. DeKorte, Presiding

1:30 57C - 1 Avoiding Misconceptions Commonly Encountered in High School and College Chemistry Texts and Courses. J. M. DeKorte
1:50 57C - 2 The Bonding in the Ozone Molecule from a Non-Resonance Point of View. M. Laing
2:05 57C - 8 A Tetrahedron of Bonding Types. M. Laing
2:20 Discussion
2:30 57C - 3 Students Explaining Chemical Demonstrations: An Experiment with Problem Solving and Cooperative Learning in General Chemistry. D. K. Erwin, J. P. Rybarczyk
2:45 57C - 4 The Newspaper as a Chemistry Textbook. R. U. Kirss, T. R. Gilbert
3:00 57C - 5 Extra Credit as a Carrot for the Use of E-mail. C. H. Snyder
3:15 Discussion
3:30 57C - 6 Workshop Chemistry at the City University of New York. D. K. Gosser, Jr., M. Weiner
3:45 57C - 7 C.C.N.Y.:Workshop Program in Chemistry. S. R. Radel, M. Roth
4:00 Discussion

More Tips and Resources
Coleman 102A
P. L. Samuel, Organizer; B. E. Wilcox, Presiding

1:30 59 - 3 Tips from the NSF: Programs in Undergraduate and Pre-college Education. S. H. Pine, D. Jones, S. Hixon
2:30 59 - 1 Resources to Make Life Easier for Chemistry Teachers. M. K. Turckes
3:15 59 - 6 From the Loch Ness Monster to the Killer Lake of Cameroon: Interesting Questions in Science. R. DeLorenzo

Chemical Demonstrations
Weis Center
P. L. Samuel, Organizer; M. Freilich, Presiding

4:15 60 - 6 Wierd Science, Video and Live: A Phenomenological Approach to Teaching. L. Marek
4:45 60 - 7 Clocks and Colors, Lights and Sounds: Teaching and Testing in the Laboratory. I. Talesnick

Tuesday Evening

7:30 S - 1 Brasted Memorial Lecture
Coleman Theater
Cost Effective Strategies for Chemical Education-Retrospective and Prospects. K. Sane

Computer Applications in the Classroom & Laboratory, Session B.
Rooke Chemistry Auditorium, Room 116
G. Sibert, P. Samuel, Organizers and Presiding

7:30 15B - 1 Vischem - Development of Multimedia Resources in Chemistry. R. F. Tasker
7:50 15B - 2 Computer-Assisted Lectures in Organic Chemistry. B. A. Luceigh
8:10 15B - 3 Proteins, An Interactive Multimedia Program for the Macintosh. B. K. Whitmarsh
8:30 15B - 4 NMR Computer Assisted Lab Instrument Operation and Principles Explanation (NMR-Calliope). R. D. Minard, F. Cusack, A. Demark, M. Heddaeus, B. Nelson, M. Trecoske, M. Whittaker

nmentally Friendly Laboratory
nents
5
:wood, J. Delfiner, Organizers and
ng

22 - 1 Candy Chromatography.
Rodriguez
22 - 2 Four Lab Activities Using
l Indicators. M. A. Haluska
22 - 3 An Environmental
itry Laboratory Component for Non-
Majors. L. A. O'Connell, M. M.
m
22 - 4 A "Nine Bottle" Type Lab
e With No Heavy Metal Waste. C. R.
r
22 - 5 A Convenient,
nsive, and Environmentally-friendly
l of Measuring the Vapor Pressure of a
as a Function of Temperature. J. H.
s
22 - 6 Pyrolysis of Iron Pyrite:
roductory Stoichiometry Experiment. A.
W. G. Davies
22 - 7 Air Stream Assisted
Scale Sublimation. P. Sattsangi
Discussion

**iter Interfacing Instrumentation in
ced Undergraduate Laboratories**
uditorium, Room 268
nussen, Organizer and Presiding

32 - 1 Rapid Estimation of
Levels with Computer-Interfaced Geiger
rs. C. C. Thompson, R. W. Sheets
32 - 2 LIMSport: Computerized
cquisition and Standard Spreadsheets.
, E. Vitz
32 - 3 Construction and Testing
iterized General Chemistry Experiments
dvanced Undergraduate Course. K. E.
N. Bonzagni, M. Hach, J. Parsons, T.
omski
32 - 4 Virtual Instrumentation.
r
32 - 5 Data Acquisition in the
nental Analysis Laboratory Using
h Notebook and Lotus 1-2-3. P. W.
ssen, A. T. MacLuckie, R. A. Hegner

s: General
1 Dining Hall
**amuel, Organizer; J. R. Pipal,
ng**

58C - 1 A Comprehensive
on of the Introductory Chemistry Course.
Henderson, H. A. DePhillips
58C - 2 Interpreting Chemical
ation from the Lay Press as Essay Exam
ons in Large Sections of General
stry. J. Laughlin, K. E. Eichstadt
58C - 3 Writing Assignments and
rative Learning Exercises for a General
stry Course. M. L. Arthur
58C - 4 Placing Students in
l Chemistry Sequences. Ten Years of
the 1981 ACS Toledo Exam. W. E.
J. R. Pipal
58C - 5 Predicting Student
mance in Liberal Arts Chemistry. D. F.
, D. Forman
58C - 6 Tested Demonstrations
lected Demonstrations in Chemistry
ne Journal of Chemical Education. G. L.

58C - 7 On Students' Lack of
rehension of the Nature of Ions: A Simple
Suggestion for Authors of General Chemistry
Texts. G. F. Wulfsberg
58C - 8 The Carcinogenic Activity
of Benzo(a)pyrene. W. E. Adams
58C - 9 Visualizing Partial
Derivatives in Thermodynamics. H. A. Ewart
58C - 10 The Use of Polyaniline as
an Electroactive Material for a Supercapacitor.
M. Reluga
58C - 11 Learning Through
Participating in C-Stes Unit Development. C.
Wang
58C - 12 The University of
Tennessee, Knoxville Pre-College Science
Outreach Programs. A. A. Hazari, A. A.
Garrison
58C - 13 TQM in the Classroom.
Using Quality Circles to Improve General
Chemistry Courses. L. S. Kogut
58C - 14 Why Did
Thermodynamics Seem So Confusing? Because
It Is! (But Need Not Be) L. J. Sacks
58C - 15 The Effect of
Structural/Taxonomic Rules on the
Identification/Naming of Compounds by
Science College Students. M. Camacho

Wednesday Morning

8:00 P - 4 Plenary Address
Weis Center
Renewables and the Energy Future. H. Chum

Innovative Teacher Education Programs
Forum, Langone Center
P. Hill, Organizer and Presiding

9:30 9A - 1 An Inquiry-based
Approach to Preservice Elementary Teacher
Education in Chemistry. J. W. Hovick, B. P.
Coppola, J. R. Lakaner, J. S. Krajcik
9:50 9A - 2 Teaching Science with
Toys: An Activity Based Pre-service Course.
J. P. Williams, A. M. Sarquis, J. L. Sarquis
10:10 Discussion
10:20 9A - 3 EFOS-A Lab Science
Intensive Curriculum for Elementary Education
Majors. P. S. Hill, R. Wilson
10:40 9A - 4 Developing an Integrated
Science Course for Elementary Education
Majors. S. D. Gammon, T. E. Bitterwolf, M. E.
Gunter, R. J. Kearney, M. J. Klowden, D. J.
Oliver
11:00 Discussion
11:10 9A - 5 Experiment in
Collaborative Learning: Progress Report. M.
A. Dugan
11:30 9A - 6 Pedagogy Seminars:
Combining Content and Method for Future
Teachers. P. S. Hill, K. A. Lauderbach
11:50 Discussion

**Transforming the Chemistry Learning
Environment**
Coleman Theater
L. Jones, Organizer and Presiding

9:30 13A - 1 Putting the Horse Before
Descartes. S. Thompson
9:50 13A - 2 Small Scale Experiments:
Changing the Dynamics of the Instructional
Laboratory. J. T. Keiser, C. M. Dolan
10:10 13A - 3 Hood College's Integrated
Lecture/Lab General Chemistry. S. W. Smith,
K. Henry
10:30 Discussion
10:45 13A - 5 Cooperative Learning:
An Approach for Large Enrollment Courses.
M. M. Cooper
11:05 13A - 4 Peer Instruction: Semi-
structured, Skill-based Study Groups. B. P.
Coppola, J. G. Kosinski
11:25 13A - 6 It's Better Together:
Transforming Chemistry Lecture Halls into
Structured Cooperative Learning
Environments. L. Geiger, L. Jones, C. Fields, I.
Karre
11:45 Discussion

**Computer Applications in the Classroom &
Laboratory, Session C**
Rooke Chemistry Auditorium, Room 116
**G. Sibert, P. Samuel, Organizers and
Presiding**

9:30 15C - 1 Introducing Chemistry
with Hypermedia. J.H. Reeves, C.R.Ward
9:45 15C - 2 Coupling Live Chemistry
Demonstrations and Laboratory Experiments
with Multimedia Software: Getting the
Concept Across to Students. T. J. Greenbowe
10:00 15C - 3 4M:Chem - A Lecture
Enhancement Tool to Present Linked Multiple
Representations of Chemical Phenomena. J.W.
Russell, R.B. Kozma, J. Davis, T. Jones, N.
Marx
10:15 Discussion
10:30 15C - 4 Stoichiometer. D.W.
Brooks
10:55 15C - 5 Developing Hypertext
Chemistry Applications for Mosaic. B. M.
Tissue
11:15 15C - 6 Computer Graphics
Visualization Experiments in General and
Organic Chemistry. S. C. Hoops, C. W.
Finley, Jr.
11:35 15C - 7 Applications of
Macintosh Software in General Chemistry for
Engineers and in Physical Chemistry. A. L.
Smith

TA Training: Solutions to Knotty Problems
Olin Auditorium, Room 268
**S. Selfe, D. Barnes, Organizers and
Presiding**

9:30 27B - 1 My Name is Ana, and I
am a Recovered Foreign TA. A Twelve Steps
Program for the Training of International
Teaching Assistants. A. M. Gaillat
10:00 27B - 2 Leadership: TA Role,
Student Goal. D. S. Barnes
10:30 27B - 3 Cooperative Learning
and Team Techniques in Teaching Assistant
Training. J. P. Birk, M. J. Kurtz
11:00 Panel Discussion

**Nurturing Chemistry Majors at Large
Universities**
Langone Center, Gallery Theater, Room 301
L. Peck, Organizer and Presiding

9:30 28B - 1 A Problem-Solving
Organic Laboratory Course. J. P. Dinnocenzo
9:55 28B - 2 Bringing Chemistry
Majors into the Community. P. C. Jurs, J. P.
Lowe, L. P. Gold, R. D. Minard, J. T. Keiser, R.
N. Henry
10:20 28B - 3 Identifying and Attracting
Potential Undergraduate Research Students
from within Large Lecture General Chemistry
Courses. T. A. Holme
10:45 28B - 4 Freshman/Sophomore
Chemistry Curriculum Augmentation at Duke
University. S. W. Baldwin, J. F. Bonk, B. O.
Fraser-Reid, N. A. Porter, P. M. Gross
11:10 28B - 5 The Challenge of Being
Both Large and Personal. J. L. Burmeister

6

Lasers in the Undergraduate Curriculum
Bio 5
V. Walters, J. de Paula, Organizers and Presiding

9:30 Introductory remarks.
9:40 **49A - 1** Let Laser Light Illuminate Your Chemistry Curriculum. G. R. Van Hecke
10:20 **49A - 2** Some Simple Laser Experiments for the General Chemistry and Quantitative Analysis Courses. L. E. Welch, D. M. Mossman, R. G. Kooser
10:40 **49A - 3** An Introductory Dye Laser Experiment for Physical Chemistry Lab. S. R. Hair
11:00 **49A - 4** Laser Photochemistry Laboratory at Potsdam College. N. Zevos, S. McCarthy, C. Smith
11:20 Panel Discussion

Teaching & Assessment of Higher Order Cognitive Skills
Vaughan Lit. Auditorium
U. Zoller, G. Bodner, Organizers and Presiding

9:30 **53 - 1** Promoting Critical Thinking in Physical Chemistry Through Guided Instruction and Mastery Learning Strategies. T. J. Zielinski
9:55 **53 - 2** Promoting Science Literacy: The Role of Meaningful Learning. S. L. Bretz
10:10 **53 - 3** Pictures and Words: Does One Yield a 1000 - Fold Increase in Understanding the Other?. C. L. Stanitski
10:30 **53 - 4** Predicting and Diagnosing Success in Introductory Chemistry Using Background, Academic, and Psychological Criteria. B. P. Coppola, O. Malanchuk, P. R. Pintrich, S. L. Yu
10:50 **53 - 5** Using Examinations for Identifying "Hocs" and "Locs Students" in Science Teaching: The Chemistry Connection. U. Zoller, G. Tsaparlis
11:10 **53 - 6** The Development of Higher Order Thinking Skills in Organic Chemistry: One Instructor's Teaching and Evaluation Methods. R. C. Bauer, G. M. Bodner, K. A. Lowrey, G. M. Loudon
11:30 **53 - 7** The Role of Representation Systems in Problem Solving in Chemistry. G. M. Bodner, D. S. Domin

Wednesday Afternoon

Innovative Teacher Education Programs
Coleman 101B
P. Hill, Organizer and Presiding

1:30 **9B - 1** Teaching Science with Toys - A Hands-on Workshop for K-12 Teachers. J. L. Sarquis, A. M. Sarquis, J. P. Williams
1:50 **9B - 2** Teaching with Hands-on Science Activities in Elementary Schools. C. Scaife
2:10 Discussion
2:20 **9B - 3** Millsaps College's Master Teaching Program in Chemistry and Biology: Have Modules - Will Train Pre-College Teachers. J. Whitfield
2:40 **9B - 4** CHEMSOURCE: A Support Strategy for Teachers of Introductory Chemistry Courses. M. V. Orna, J. O. Schreck, D. Gabel
3:00 Discussion
3:10 **9B - 5** Partners for Terrific Science. A. M. Sarquis
3:30 **9B - 6** Teachem: An Organization Dedicated to Improving How High School and College Faculty Teach Chem. A. H. Martin, R. Arlotto
3:50 Discussion

Conversation: What is the Role of AP Chemistry in the Third Millennium?
Coleman 102A
A. Arnold, Organizer and Presiding

1:30 **10 - 1** Teaching AP Chemistry for the First Time. A. Arnold
1:40 **10 - 2** Building on the AP Experience. P. L. Samuel
1:50 **10 - 3** How "Advanced" is Advanced Placement Chemistry? W. J. Gleekman
2:00 **10 - 4** A Discussion of Advanced Placement Chemistry. N. Kildahl
2:10 **10 - 5** AP Chemistry on an Independent Study Basis. M. Readnour
2:20 - 4:00 Discussion

Conversation: Why is Chemistry Useful for Engineers?
Coleman 204A
M. Pavelich, Organizer and Presiding

1:30 **12 - 1** What Chemistry Should Engineering Students Study? M. J. Pavelich, T. R. Wildeman
1:40 **12 - 2** Chemistry Courses for Engineers at Purdue University. D. Ben-Amotz, G. M. Bodner
1:50 - 3:30 Discussion

Transforming the Chemistry Learning Environment
Olin Auditorium, Room 268
L. Jones, Organizer and Presiding

1:30 **13B - 1** Using Calculated Atomic and Molecular Images in the High School Chemistry Classroom. B. E. Rowe
1:50 **13B - 2** Integrating New Techniques with Traditional Methods in the General Chemistry Lecture. H. E. Pence
2:10 **13B - 3** Computer Support for Interactive Lectures. J. S. Martin
2:30 Discussion
2:45 **13B - 4** New Approaches in General and Inorganic Chemistry. J. C. Kotz
3:05 **13B - 5** Chemistry 101 Multimedia: Interactive Learning Tools for the MTV Generation. I. K. Stovall, R. B. Wilson
3:25 **13B - 6** Introductory College Chemistry Courses Presented by "Distance-Learning" Methodology. R. H. Paine, G. A. Takacs
3:45 Discussion

Computer Applications in the Classroom and Laboratory, Session D
Rooke Chemistry Auditorium, Room 116
G. Sibert, P. Samuel, Organizer and Presiding

1:30 **15D - 1** Labview Data Acquisition and Data Analysis Routines: A Tool for the Revitalization of General and Physical Chemistry Labs. J. R. Hutchinson
1:50 **15D - 2** Computer-Interfaced Experiments in a Laboratory-Centered Curriculum. N. L. Devino, C. Samet
2:10 **15D - 3** A Computer-Based Laboratory Curriculum For General Chemistry. J. C. Hansen
2:30 **15D - 4** Use of IBM Personal Science Laboratory (PSL) and Microsoft Windows and EXCEL in General Chemistry Laboratory. J. R. Zimmer, J. Reeves, C. Ward
2:50 **15D - 5** Computers in Chemistry Laboratory Instruction: The CCLI Initiative. S. Arena, J. Amend, R. Furstenau, D. Hammond, D. King, S. Nussbaum, M. Seymour, J. Weyh
3:10 **15D - 6** Computers in Chemistry Laboratory Instruction: The CCLI Initiative. D. Hammond, J. Amend, S. Arena, R. Furstenau, D. King, S. Nussbaum, M. Seymour, J. Weyh
3:30 **15D - 7** Implementing a Digital-Voltmeter General Chemistry Lab Computer Interface. H. B. Thompson, I. Morken

New Directions in Inorganic Chemistry
Gardner Auditorium, Dana 132
W. Anderson, A. Pribula, D. Finster, Organizers and Presiding

1:30 **19 - 1** Computer-generated Pourbaix Diagrams and Descriptive Inorganic Chemistry. J. P. Birk, L. L. Tayer
1:50 **19 - 2** A Crystal Building and Viewing Program for Use with HyperchemTM. A. Viste, W. P. Anderson
2:10 **19 - 3** Compiled Spreadsheets. L. M. Wier
2:30 **19 - 4** A Ligand Field Program for use in Inorganic Chemistry Courses. W. P. Anderson
2:50 Discussion
3:00 **19 - 5** Methods for Incorporating the Chemistry of the Elements into an Introductory Inorganic Laboratory. J. C. Woolcock
3:20 **19 - 6** Curriculum Modifications to Include More Inorganic Chemistry. J. A. Smieja
3:40 **19 - 7** Teaching Less, Learning More. D. C. Finster

New Methods for Laboratory Teaching
Forum, Langone Center
M. Cooper, Organizer and Presiding

1:30 **29A - 1** Inquiry in Introductory Labs: Why, What, and How. N. K. Kerner
2:00 **29A - 2** Cooperative Chemistry Laboratories. M. M. Cooper
2:30 Discussion
2:45 **29A - 3** Changing from a Directive Approach to an Exploratory Approach in the General Chemistry Laboratory: Helping Students Think About Chemistry. S. A. Heideman, T. J. Greenbowe
3:05 **29A - 4** Yes Virginia, a Discovery Based General Chemistry Lab Experiment is Possible. L. R. Allen
3:25 **29A - 5** Conveying Some Sense of What Chemists Really Do. G. E. Rodgers, R. L. Bivens, E. J. Walsh, S. R. Hair, B. R. Reid, M. J. Serra, A. E. Sheffield
3:45 Discussion

Incorporating Modern Biochemical Techniques into Chemistry & Biology Curricula: New Experiments & New Course Designs
Coleman 203B
C. Clapp, M. Chemin, Organizers and Presiding

1:30 **36 - 1** An Independent Study of Enzymes as Part of the First Year Biochemistry Laboratory. C. L. Bering
1:55 **36 - 2** Determination of the Amino Acid Content and Stereochemistry of Biologically Active Pentapeptide. J. W. LeFevre

2:20 36 - 3 Capillary Electrophoresis in the Instrumental Analysis Course: Determination of Analgesic Formulations. T. G. Strein, H. Veening
2:45 36 - 4 Undergraduate Advanced Biochemistry Laboratory: Genetic Manipulation of Protein Structure & Function. D. C. Speckhard
3:10 36 - 5 An Advanced Laboratory Course at the Interface of Chemistry and Biology. C. H. Clapp, M. I. Chemin, K. Garrison, J. C. Wallace
3:35 Discussion

Chemical Researchers, Chemical Journals & Libraries: New Information Technologies in Support of Chemical Education
Seminar Room, Room 213A Bertrand Library
J. Van Fleet, Organizer and Presiding

1:30 39 - 1 Do Chemical Researchers Need Chemical Journals? Do They Need Libraries? J. A. Van Fleet
2:15 39 - 2 Evaluating the Chemistry Journal Collection in Light of Decreasing Budgets and Increasing Use of Electronic Access. M. Johnson
3:00 39 - 3 A Chemical Literature Management System Using Endnote. C. Myers, R. L. Musselman

Conversation: Using Models in Chemistry Teaching
Coleman 202A
K. Eichstadt, D. Bagley, Organizers and Presiding

1:30 45 - 1 Some Thoughts on Models in Introductory Chemistry. T. F. Block
1:40 45 - 2 Making Connections in High School Chemistry with Three-dimensional Models of Biologically Important Molecules. D. H. Bagley
1:50 45 - 3 Extending the Rutherford Discovery Model. J. Penna
2:00 45 - 4 Using Analogies to Teach First Year Chemistry Topics. J. Daniels
2:10 45 - 5 A Compendium of Models and Analogies from the Journal of Chemical Education for Classroom Instruction. K. E. Eichstadt
2:20 - 4:00 Discussion

1:30 - 4:00 47 - 1 **Teaching and Evaluation of Critical Thinking**
Coleman Theater
U. Zoller

New Approaches to Teaching Organic Chemistry
Coleman 103B
R. Minard, Organizer and Presiding

1:30 48B - 1 Using the "Demonstrations in Organic Chemistry" Videodisc in the Classroom. G. L. Trammell
1:55 48B - 2 Macintosh Computers in Organic Chemistry Lecture and Lab. D. E. Marko, J. Z. Gillies, E. W. Wolpaw
2:20 48B - 3 A New Approach for Including Molecular Modeling in Undergraduate Courses. J. O. Currie, Jr.
2:45 48B - 4 Active Learning Techniques in the Chemistry Classroom. M. Katz
3:10 Break
3:20 48B - 5 Critical Thinking: Predictor of Success in Organic Chemistry? L. D. Berg
3:40 48B - 6 Taking a Back Seat in the Classroom. E. Wildi
4:00 48B - 7 Student-Directed Learning: A Technique Which Promotes Independence and Responsibility in the Student. M. Katz
4:25 48B - 8 A Discovery-based Approach to Sophomore-level Organic Chemistry. F. J. Creegan

Lasers in the Undergraduate Curriculum
Bio 5
V. Walters, J. de Paula, Organizers and Presiding

1:30 Introductory remarks.
1:40 49B - 1 Multiple Uses of a Nitrogen Laser in the Undergraduate Curriculum. V. A. Walters
2:00 49B - 2 High-Resolution Laser Spectroscopy in the Physical Chemistry Laboratory. J. M. Brom
2:20 49B - 3 Photochemistry of Ruthenium(II) Polypyridyls. J. C. de Paula, R. C. Scarrow, L. Hurwitz
2:40 49B - 4 Laser-Induced Fluorescence Studies of Molecular Collision Dynamics. T. A. Stephenson
3:00 49B - 5 Lasers in Undergraduate Physics and Electrical Engineering: Pedagogical and Research Applications. L. A. Molter
3:20 49B - 6 Gas-Phase Fragmentation Patterns in Organometallic Compounds: Undergraduate Research Using an Excimer-pumped Dye Laser. W. E. Hollingsworth
3:40 49B - 7 Polarized Absorption/Emission - A Neglected Technique. B. A. DeGraff, L. Christianson

Is An Associate Degree Detrimental to an Academic Future?
Langone Center, Gallery Theater, Room 301
J. Herron, M. Schumm, Organizer and Presiding

1:30 55 - 1 Ford Foundation Supported Study. "State Higher Education Systems and College Completion". G. Orfield and F. Paul. J. D. Herron, M. K. Schumm
1:45 55 - 2 Is an Associate Degree Detrimental to an Academic Future? A Study of a National Sample of Students. C. R. Nunley
2:05 55 - 3 The Community College Route Retraced. D. R. Brown
2:25 55 - 4 Is an Associate Degree Detrimental to an Academic Future? B. J. Keener
2:45 55 - 5 Stories from the Margin: The Uses of the Community College. J. O. Stevenson
3:05 55 - 6 A.S. Degree as Stepping Stone to an Academic Future. H. I. Karan, J. Flowers

Research in Education - Examples
Coleman 203A
P. L. Samuel, Organizer; M. R. Walsh, Presiding

1:30 57D - 1 Effects of an Integrated Video-enhanced High School Chemistry Curriculum on Student Attitudes and Achievement. W. S. Harwood, M. McMahon, L. Ragsdale, N. Ben-Zvi
1:45 57D - 2 Authentic Assessment in the High School Chemistry Classroom. M. R. Walsh
2:00 Discussion
2:10 57D - 3 Student Experiences in College General Chemistry: Affective Influences on Decisions About Majoring in Science. L. Meadows
2:25 57D - 4 A Qualitative Study of the Effects of a Constructivist Method of Laboratory Instruction on College Students' Conceptual Change, Achievement, Attitude, and Perception. D. Lewicki
2:40 57D - 5 Learning Chemistry in the Classroom by Doing Chemistry Innovatively. L. Meadows, L. Grynkewich
2:55 Discussion
3:10 57D - 6 Problem-Solving Technique Used in Teaching Integrated Science. T. A. Asunta
3:25 57D - 7 Exploratory Research Related to Laboratory Instruction and its Learning Outcomes in Chemistry & Across the Sciences. J. Schmuckler, F. Sutman, M. Zhou, A. Hilosky
3:40 Discussion

More Tips and Resources
Coleman 1A
P. L. Samuel, Organizer; J. R. Pipal, Presiding

1:30 59 - 4 Scientific Creativity: Gedank Experiences in College Chemistry. A. K. El-Ashmawy
2:15 59 - 5 Chemistry Through the Ages. N. LeMaster, E. Martin, D. Ravenel
3:00 59 - 2 A Workshop in Writing Successful Proposals. M. K. Turckes

Chemical Demonstrations
Weis Center
P. L. Samuel, Organizer; M. Freilich, Presiding

4:15 60 - 8 Spectacular Chemical Demonstrations - Without Flames, Explosions, or Mess. J. Bell, B. Shakhashiri

Thursday Morning

8:00 P - 5 Plenary Address
Weis Center
Doing Chemistry at the Art/Archeology Interface. M. V. Orna

Transforming the Chemistry Learning Environment
Olin Auditorium, Room 268
L. Jones, Organizer and Presiding

9:30 13C - 1 Teaching Organic Chemistry with Team Learning and Case Studies. F. J. Dinan, J. F. Bieron
9:45 13C - 2 Interactive Learning in Thematically Integrated Freshman Chemistry. F. Garafalo, R. Toomey, V. LoPresti
10:00 13C - 3 Use of Linked Multiple-Window Computer Visualizations to Develop Mental Models of Chemical Concepts. J. W. Russell, R. B. Kozma, P. Baggett, J. Davis, T. Jones, N. Marx
10:15 Discussion
10:30 13C - 4 Hypermedia Presentations on a PC; Tools to Smooth the Path. J. H. Reeves, C. R. Ward
10:45 13C - 5 Don't Just Lecture on Chemistry, Present it. M. M. Ali
11:00 13C - 6 Collaborative Learning of Stoichiometry. V. L. Hess
11:15 Discussion

Computers in the Classroom: A Basis from Research and Assessment
Coleman 103B
J. Hood, Organizer and Presiding

9:30 **14 - 1** The Computer: A Tool for Chemical Education Research. D. S. Domin, G. M. Bodner
9:55 **14 - 2** Evaluating the Use of Computers in the Chemistry Classroom. B. J. Hood
10:20 Discussion
10:35 **14 - 3** Problem Sequencing Strategies in Computer Based Instruction. M. P. Doherty, G. M. Bodner
10:55 **14 - 4** Evaluation of Required CAI Use by Freshman Chemistry Students. J. D. Spain
11:15 Discussion

Computer Applications in the Classroom & Laboratory, Session E
Rooke Chemistry Auditorium, Room 116
G. Sibert, P. Samuel, Organizers and Presiding

9:30 **15E - 1** Boogie at the Disco_Using NCSA Tools on the Macintosh to Model Atoms and Molecules. B. E. Rowe
9:50 **15E - 2** CD-ROMs for Chemistry Teachers. H. B. Brooks, D. W. Brooks
10:10 **15E - 3** Vizquiz - A Multimedia Vehicle for Test and Homework Evaluation. R. D. Allendoerfer, J. W. Moore, J. A. McCormick
10:30 **15E - 4** HyperCard and Desktop Publishing in the High School Chemistry Classroom. M. G. Sibert
10:50 **15E - 5** Chemprof: Teaching Equation Balancing. A. A. Eggert, C. H. Middlecamp, A. T. Jacob
11:10 **15E - 6** Images of Research in General Chemistry. J. R. Appling
11:30 Discussion

New Methods for Laboratory Teaching
Coleman Theater
M. Cooper, Organizer and Presiding

9:30 **29B - 1** A General Chemistry Laboratory Program Focusing on "Real World" Substances. R. C. Kerber, M. J. Akhtar
9:50 **29B - 2** Chemistry Gets Real. C. M. Pharr, S. D. Gammon, J. D. Jegla, B. J. Malmberg
10:10 **29B - 3** The Analytical Process in Chemistry Lab. R. J. Eiernun
10:30 Discussion
10:45 **29B - 4** What Did This Guy Do Wrong?. D. M. Whisnant
11:05 **29B - 5** Macintosh Computers in General Chemistry Laboratory. E. W. Wolpaw, J. Z. Gillies, T. A. Pardo
11:25 **29B - 6** A Writing Intensive-Open Inquiry Physical Chemistry Lab. G. R. Long
11:45 Discussion

Innovative & Investigative Microscale Chemistry
Gardner Auditorium, Dana 132
M. Singh, Organizer and Presiding

9:30 **30 - 1** The Microscale Laboratory: Innovative Experiments and Techniques - An Update. R. M. Pike, M. M. Singh, Z. Szafran
9:55 **30 - 2** Microwave Microscale Organic Experiments. J. W. Elder, K. M. Holtz
10:15 **30 - 3** Innovative Microscale Chemistry Experiments for General and Advanced General Chemistry. M. M. Singh, Z. Szafran, R. M. Pike
10:35 **30 - 4** Photon-Initiated Hydrogen-Chlorine Reaction: A Versatile and Exciting Microscale Experiment. J. T. Keiser, L. M. Egolf
10:55 **30 - 5** Microscale Multistep Synthesis of a Novel Heterocyclic Compound. R. Fowler
11:15 **30 - 6** Microscale Electrophilic Substitution of P-Toluidine. I. O. Kady

Contemporary & Affordable Physical Chemistry Experiments
Coleman 101A
E. Walters, Organizer and Presiding

9:30 **35 - 1** The P-CHEM Lab Problem: There's an Easy Solution and it's Wrong. G. D. Brabson
10:00 **35 - 2** Gas Phase Physical Chemistry Experiments. E. A. Walters
10:20 Discussion
10:40 **35 - 3** A Combined Advanced Laboratory Course. K. W. Loach, E. J. Miller, N. J. Mammano, R. K. Sandwick, W. E. Krueger
10:55 **35 - 4** Thermodynamic Properties of Air. F. M. Hornack
11:10 **35 - 5** Conductivity, A Simple Method to Probe Micellar Solutions. S. J. Bachofer
11:25 Discussion

9:30 - 11:30 Conversation: Designing Laboratory Classrooms to Support Instructional Goals
Coleman 102A
J. Phillips, Organizer and Presiding

9:30 - 11:30 **37 - 1** The Academic Laboratory - Enhancing Safe and Effective Chemical Education. J. M. Phillips

Chemistry Majors Courses/Curriculum
Coleman 101B
P. L. Samuel, Organizer; M. N. Ackermann, Presiding

9:30 **57E - 1** Blurring the Boundaries: Undergraduate Chemistry Education in the Nineties. C. Samet, N. Devino, M. Holden, R. Leyon, G. Roper
9:50 **57E - 2** A More Flexible Chemistry Curriculum. M. N. Ackermann
10:10 Discussion
10:20 **57E - 3** The Nature of the Chemical Bond Studied by FT-IT Spectroscopy: An Introductory Chemistry Laboratory Experiment Using Cooperative Learning. D. M. Hayes, J. S. Anderson, T. C. Werner
10:35 **57E - 4** New Curriculum Model Using Cooperative Learning and Computers in Analytical Chemistry Courses. J. C. Wright
10:50 **57E - 5** Undergraduate Research at the Industrial Interface. P. E. Beck
11:05 Discussion

First-Year Chemistry Curriculum
Vaughan Lit. Auditorium
P. L. Samuel, Organizer; A. P. Zipp, Presiding

9:30 **57F - 1** The Introductory Chemistry Curriculum: Alternatives and Innovations. L. H. Rickard
9:45 **57F - 2** New Directions in General Chemistry. J. N. Spencer
10:00 Discussion
10:10 **57F - 3** Chemistry and the Human Environment - A Need-to-Know Approach. C. N. Trumbore
10:25 **57F - 4** The UIC Match Program: A Combined Math and Chemistry Preparatory Curriculum. D. J. Wink, S. M. Fetzer, S. D. McNicholas
10:40 Discussion
10:50 **57F - 6** Using "Chemistry in Context" in Courses for Science Majors. A. P. Zipp
11:05 **57F - 7** A New Introductory Course Sequence for Science Majors Based on Chemistry in Context. W. J. Stratton, G. Bakker, J. Hansen, P. Ogren
11:20 **57F - 8** Chemistry in Context for Science Majors at Antioch College. S. Bernstein
11:35 Discussion

Using History in Teaching Chemistry
Coleman 202A
P. L. Samuel, Organizer; K. C. Scantlebury, Presiding

9:30 **57G - 1** Successful Women in Science. M. R. Joseph
9:50 **57G - 2** Women's Fields of Chemistry: 1900 - 1920. G. W. Rayner-Canham, M. F. Rayner-Canham
10:10 **57G - 3** Maria Edgeworth: Eighteenth Century Pioneer of Chemical Education. K. C. Scantlebury
10:30 Discussion
10:40 **57G - 4** The Unwelcome Dr. Priestley. J. E. White
11:00 **57G - 5** Anecdotal Biographies and Caricatures of the Men and Women Taught in 1st Year Chemistry. R. M. Robacker
11L30 Discussion

Chemical Demonstrations, *M. Freilich and P. L. Samuel, Organizers*

Monday Afternoon

4:15 Weis Center
60-1 TO PLANET EARTH WITH LOVE FROM CHEMISTRY. Ann Hubbard, Reigate College, Surrey, U.K.

Opening up a treasure chest of molecules, the lecture shows how experiments such as crystal castles, acid fountains, an artist's palette and a tournado can keep an audience entertained. You can touch gooey green slime and perhaps almost go to Mars and be back in time for tea. The lecture is about communicating enthusiasm. It is a celebration of the 600th anniversary of the Salters' Company and the 150th anniversary of the Royal Society of Chemistry.

4:45 Weis Center
60-2 POLYMER AND PLASTIC CHEMISTRY DEMONSTRATIONS Valerie Wilcox, Executive Director, National Plastics Center and Museum, Leominster, MA

The chemistry of polymers and plastics lends itself well to several exciting, timely demonstrations. This presentation will focus on the best of these, with particular attention to why plastics behave they way they do and the pervasive role they play in our lives. (Why is a balloon like a plate of spaghetti?) Issues of disposal will also be discussed.

Monday Evening

7:00 Olin Auditorium
60-3 CHEMICAL DOMINO DEMONSTRATION II. M. D. Alexander, Department of Chemistry and Biochemistry, New Mexico State University, Las Cruces, New Mexico 88003

Chemical domino demonstration II is an extension and improvement of the chemical domino demonstration first presented at the 10th BCCE, Purdue University. The new version consists of a series of eighteen different chemical reactions occurring in sequence. Reactions include acid-base neutralizations, redox reactions, decompositions, coordination complex substitution reactions, metathesis reactions and combustion reactions. The presentation consists of a description of the apparatus, discussion of the chemical reactions, and a video tape presentation of the demonstration.

7:20 Olin Auditorium
60-4 CHEMICAL DEMONSTRATION: LIVE AND VIDEOTAPED. John J. Fortman, Dept. of Chemistry, Wright State University, Dayton OH 45435

There is an appropriate use for both live and videotaped chemical demonstrations in the classroom. Currently there are available a large variety of videotapes featuring various styles and approaches. Samples from many different tapes which illustrate when videos are most useful will be shown interspersed with some simple but effective live demos. Some reasons for using videos of some demos include: danger, expense, difficult set-up, complex operations, unavailable equipment, instant replay, close-ups of small demos, slow motion action, microscopic views, and visual graphics.

Monday Evening

8:00 Olin Auditorium

60-5 ACIDS AND BASES IN LIVING COLOR. Herb Bassow, Germantown Friends School, Philadelphia, PA 19144

A series of demonstrations, using conductivity measurements, acid-base indicators, precipitation reactions, with aqueous solutions of several acids, several bases, and several salts. The demonstration will be used to provide a logical development of the ideas of Arrhenius as well as Bronsted and Lowry. The concepts of conjugate acid-base pairs and of acid strength will be included.

The above development has been used successfully by the author with first-year high school students, and will be presented at this elementary level, emphasizing the interplay between operational and conceptual definitions.

Tuesday Afternoon

4:15 Weis Center

60-6 WEIRD SCIENCE, VIDEO AND LIVE: A PHENOMENOLOGICAL APPROACH TO TEACHING. Lee Marek, Naperville North High School, Naperville, IL.

Those sultans of chemical high jinks are back with demonstrations and some video, and teaching tips that will turn on even the most comatose students. Students learn best when they want to learn. It is our job at the high school level to awaken their desire to learn - to keep the students mentally coming back. You can't communicate with people who are not present. If you want "presence", you have to capture attention. Four members of Chemistry West (aka Weird Science), a Chicago-area chemistry teachers' alliance network group, have developed a number of short, easy, and sometimes "weird" demonstrations to grab or hook students into thinking about the day's topic and to convince the class that their teacher is an eccentric. Live demonstrations will be coupled with videos of demonstrations they have done for their television show, Weird, Weird Science.

4:45 Weis Center

60-7 CLOCKS AND COLORS, LIGHTS AND SOUNDS: TEACHING AND TESTING IN THE LABORATORY. Irwin Talesnick, Faculty of Education, Queen's University, Kingston, Ontario

Observe a variety of laboratory activities in areas related to chemistry. Each of the experiments is designed to motivate students to think, discuss, and to science. These experiments can be modified for use at any grade level. Appropriate safety precautions will be used and discussed. Return to your classroom with a refreshed and refreshing approach to the teaching of science and share with your students the love of science and sciencing.

Wednesday Afternoon

4:15 Weis Center

60-8 SPECTACULAR CHEMICAL DEMONSTRATIONS - WITHOUT FLAMES, EXPLOSIONS, OR MESS. Jerry A. Bell, Director, Science, Mathematics and Technology Education, American Association for the Advancement of Science, and Bassam Z. Shakhashiri, Professor of Chemistry, University of Wisconsin

Spectacular demonstrations that catch students' attention and spark their thinking (without flames, booms, or mess - much) are possible as well as safe and pedagogically rewarding. We will present a series of such demonstrations, featuring many on the chemical and physical properties of gases that intrigue and mystify students until they are led to pull together several strands of their chemical knowledge.

Birds-of-a-Feather Sessions

These informal birds-of-a-feather sessions provide an opportunity for people interested in a common topic to meet others with similar interests and to explore and share ideas on the topics. Typically these sessions last about an hour; bring your lunch if it is a noon session. Any other *ad hoc* sessions will be announced in the daily newsletter. Stop by the information desk in the Langone Center to leave your message for the newsletter.

Monday

Freas Hall, University Lounge
12:00 - 1:15 **70 - 1 Textbook Authors Association** Are you the author of a textbook? Meet fellow writers learn about the Textbook Authors Association at this session. Toby Block, convener

Tuesday

Coleman 1A
12:00 - 1:15 **70 - 2 Chemistry in Context: Sharing the Experience** "A general discussion session for those who have used the Chemistry in Context book or plan to in the near future. The purpose is to share teaching ideas and experiences." Bob Silberman, convener.

Coleman 101A
12:00 - 1:15 **70 - 3 Committee on Computers in Chemical Education** Get acquainted with the activities and members of the CCCE, a committee of the Division of Chemical Education. Don Rosenthal, convener.

Freas Hall, University Lounge
12:00 - 1:30 **70 - 4 "Chemical Reform and The Chemical World: What Works in the Classroom".** Current users of The Chemical World textbook (by Jack Kotz, Mel Joesten, Jim Wood and John Moore) will discuss how they are actively incorporating the goals of chemical reform into the reality of the classroom. Educators from two and four year schools will find this an interesting and interactive workshop that focuses on what is working in both course content and textbooks, what student response has been, and how the "reformed" general chemistry course is evolving. Workshop leaders will be John Fortman (Wright State University), Mary O'Brien (Edmunds Community College) and Art Ellis (University of Wisconsin-Madison). Sign up at the Saunders College Publishing booth!

Coleman 1B
12:00 - 1:15 **70 - 5 Conversation: New Kid on the Block: Assistant Professors and Success in the First Several Years** This session is a forum where young assistant professors are able to share their experiences (good and bad) and frustrations from their first few years in academics. Topics such as teaching, research, academic service and advising, and tenure will be discussed. Andrew Price, convenor

Coleman 103B
12:00 - 1:15 **70 - 6 Project Totem: The Large Laboratory Curriculum Group** We are a group of laboratory directors at large universities and two-year colleges. Our mission is substantive reform of the first-year chemistry laboratory curriculum. Meet fellow-laborers in the teaching laboratory vineyard and get an update on Totem at this session. Bring your questions and ideas! Patricia Samuel, convenor

Wednesday

Library Lab, Lower Level 1

STN and CAS-On-Line Users or Users-Want-a-be, are welcome at informal question and answer sessions with represetnatives from STN. Robert Zuzac, convenor

9:30 - 10:30 70 - 7 The types of Scientific & Technical Information found on STN will be demonstrated and reviewed.

11:00 - 12:00 70 - 8 Open Discussion - Question and answer period regarding the products and services offered by CAS and STN International.

1:00 - 2:00 70 - 9 The types of Scientific & Technical Information found on STN will be demonstrated and reviewed.

2:30 - 3:30 70 - 10 Open Discussion - Question and answer period regarding the products and services offered by CAS and STN International.

Coleman 102A
12:00 - 1:15 70 - 11 **Interfacing High School & First Year College Chemistry.** This session is for teachers of high school and first year college/university chemistry to exchange ideas about curriculum and other issues of common interest. Come and meet like-minded colleagues. Patricia Samuel, convenor.

Coleman 1A
12:00 - 1:15 70 - 12 **The Next Generation of Organic Chemistry Texts** The organic chemistry textbooks currently available presumably reflect the subject matter deemed to be most important by academic organic chemists. However the needs and backgrounds of students have changed greatly. The text have become too voluminous to permit the addition of any significant amount of material. Clearly some topics will have to be sharply curtailed or dropped. Rather than taking a piecemeal approach, why not engage in discussions which will lead to the next generation of organic texts? Geoff Brieger, convenor

Coleman 1B
12:00 - 1:15 70 - 13 **Un-Confusing Thermodynamics.** Can one teach thermodynamics for understanding rather than just "getting through"? Need thermodynamics be a barrier to becoming a chemist? Attend this session for a discussion of a different approach. See abstract 58C-14, Tuesday evening posters, for more information. L. J. Sacks, convenor

Freas Hall, University Lounge
12:00 - 1:15 70 - 14 **Open Forum: High School Chemistry Committee, Division of Chemical Education, American Chemical Society.** This session is open to anyone interested in having input into the High School Chemistry Committee of the Division of Chemical Education, American Chemical Society. Suggestions for future directions will be welcomed! Diane Gerlach, Chairperson-Elect, convenor

Freas Hall, University Lounge
1:30 70 - 15 **Business Meeting: High School Chemistry Committee, Division of Chemical Education, American Chemical Society.** This session is a business meeting for the regional coordinators of the High School Chemistry Committee. The focus of this business meeting is a discussion of the future directions for HSCC. If you are interested in participating on this committee, please attend the Open Forum which is scheduled at 12:00 - 1:15. Diane Gerlach, Chairperson-Elect, convenor

Thursday

241 Langone Center
12:00 - 1:30 70 - 16 ***Pennsylvania Association of College Chemistry Teachers.*** Pennsylvanians are welcome to come meet each other and to discuss plans for future meetings. People from other states are welcome to come share ideas with us. Sally Solomon, convenor.

Workshops

Descriptions follow the schedule.

Sunday Morning

8:00-5:00 **111:** Demonstrations in Chemistry: For the Love of Science and Sciencing. **Rooke 107-110 and Rooke 102**
8:00-12:00 **115:** Chemistry in Microscale: An Introduction to Microscale Experiments. **Bio Lab 112-114**
9:00-12:00 **128:** ACS Satellite Television Seminar Teaching Chemistry, 1994 **Bio 5**

Sunday Afternoon

1:30-4:30 **100:** Priestley House Pilgrimage **Bus Stop**
1:00-5:00 **105:** An Introduction to ChemSource and SourceBook on CD-ROM **Rooke Mac Lab**
1:00-5:00 **114:** Chemistry in Microscale: Advanced Microscale **Bio Lab 112-114**
1:30-4:30 **128:** ACS Satellite Television Seminar Teaching Chemistry, 1994 **Bio 5**

Monday Morning

9:15-12:15 **101:** Chemistry in Context **Bio 102 and 105**
9:30-10:30 **102:** The PSI-PET Physical Science Course for Prospective Elementary Teachers. **Bio 108**
10:00-12:00 **104:** ChemSource: SourceBook Laboratory Activities. **Bio 115**
9:15-12:15 **108:** SIRs, Smart Instructor's Resources for the IBM. **Rooke 17, IBM Lab**
9:30-11:30 **110:** Computation in the Undergraduate Curriculum - Introductory Demonstration **Gallery Theatre, Langone Center**
9:15-6:15 **111:** Demonstrations in Chemistry: For the Love of Science and Sciencing. **Rooke 107-110 and Rooke 102**
10:00-12:00 **117:** Computer Tutorial: IR TUTOR, An Animated Approach to Spectroscopy in the Classroom and Laboratory. **Olin Auditorium**
9:15-12:15 **124:** Introducing Students to Chemical Information Sources. **Library Lab**
9:15-12:15 **128:** ACS Satellite Television Seminar Teaching Chemistry, 1994 **Bio 5**

Monday Afternoon

1:00-5:00 **100:** Priestley House Pilgrimage **Bus Stop**
2:00-4:00 **104:** ChemSource: SourceBook Laboratory Activities. **Bio Lab 115**
1:15-5:15 **105:** An Introduction to ChemSource and SourceBook on CD-ROM **Rooke 9, Mac Lab**
2:00-3:00 **109:** How to Make CAI Make a Difference. **Gallery Theatre, Langone Center**
1:30-4:00 **110:** Computation in the Curriculum, hands-on session **Langone 302**
1:15-5:15 **112:** Hey..If I Can Do It, You Can Do It! Practical Tips for Doing Hands-On Science with Elementary School Students! **Bio Lab 110**
1:15-5:15 **115:** Chemistry in Microscale: An Introduction to Microscale Experiments. **Bio Lab 112-114**
1:15-4:15 **119:** FTNMR Simulations on the IBM PC. **Dana 227, IBM Lab**
1:30-4:30 **128:** ACS Satellite Television Seminar **Bio 5**
2:00-4:00 **136:** Chemistry with Computers. **Rooke 116, Auditorium**
1:15-4:15 **142:** PC Based Molecular Modeling **Olin 261**

Monday Evening

6:30-10:30 **100:** Priestley House Pilgrimage **Bus Stop**
6:00-8:00 136: Chemistry with Computers. **Rooke Auditorium**

Tuesday Morning

9:15-12:15 **100:** Priestley House Pilgrimage **Bus Stop**
10:00-12:00 **103:** ChemSource: The Pre-Service Guide and Usage of Videotapes and Laser Disks. **Dana 307**
9:15-12:15 **106:** Safety in the Laboratory - The Chemical Hygiene Plan. **Rooke 116, Auditorium**
9:15-12:15 **108:** SIRs, Smart Instructor's Resources for the IBM. **Rooke 17, IBM Lab**
9:30-12:00 **110:** Computation in the Curriculum, hands-on session **Langone 302**
9:15-12:15 **118:** Modern Methods of IR Spectroscopy. **Olin Lab 274**
9:15-12:15 **119:** FTNMR Simulations on the IBM PC. **Dana 27, IBM Lab**
9:15-12:15 **123:** Essay Writing in Chemistry Classes. **Bio 101**
9:15-12:15 **125:** Search CAS On-Line. **Library Mac Lab**

9:15-12:15 129: Sliming, Floating, Glowing, Sinking-Teaching Science With TOYS on the Road. **Bio Lab 108**

Tuesday Afternoon

1:15-4:15 100: Priestley House Pilgrimage **Bus Stop**
2:00-4:00 103: ChemSource: The Pre-Service Guide and Usage of Videotapes and Laser Disks. **Dana 307**
1:15-5:15 105: An Introduction to ChemSource and SourceBook on CD-ROM **Rooke 9, Mac Lab**
1:15-3:00 106: Safety in the Laboratory - The Chemical Hygiene Plan (continued) Mac Hands On **Coleman 2B, Mac Lab**
1:15-3:00 106: Safety in the Laboratory - The Chemical Hygiene Plan (continued) IBM Hands On **Rooke 17, IBM Lab**
1:30-4:00 110: Computation in the Curriculum, hands-on session **Langone 302**
1:15-5:15 116: Microscale in Inorganic Chemistry **Rooke 335, Organic Lab**
1:30-4:30 118: Modern Methods of IR Spectroscopy. **Olin Lab 274**
1:15-4:15 121: Introduction to Optoelectronics. **Dana 347**
1:15-4:15 125: Search CAS On-Line. **Library Mac Lab**
1:30-3:30 132: Chemistry is for Everyone. **Bio Lab 110**
3:00-5:00 141: Laboratory Safety Program. **Bio 5**

Tuesday Evening

6:30-7:30 107: Small Scale and Doing Chemistry Experiments on CD-ROM **Rooke 116, Auditorium**

Wednesday Morning

9:15-12:15 100: Priestley House Pilgrimage **Bus Stop**
9:15-12:15 101: Chemistry in Context **Bio 102 and 105**
9:30-12:00 110: Computation in the Curriculum, hands-on session **Langone 302**
9:15-12:15 118: Modern Methods of IR Spectroscopy. **Olin Lab 274**
9:15-12:15 120: Superconductors, etc **Olin Lab 271**
9:15-12:15 130: Chemistry Demystified. **Bio 108**
10:00-12:00 131: Keeping Your Apple in Use **Olin Lab 261**
9:15-10:15 134: A Model System for Teaching Structure, Bonding and Hybridization. **Bio 110**
11:00-12:00 134: A Model System for Teaching Structure, Bonding and Hybridization. **Bio 110**
9:30-11:30 137: Numerical Methods in Physical Chemistry Using MATHCAD. Introductory Lecture. **Rooke 18 Case Room**
9:15-11:15 138: User Friendly Instrumentation for High School Chemistry Classes. **Bio Lab 115**
9:15-5:15 140: Laboratory Safety. **Bio 104**

Wednesday Afternoon

1:15-4:15 100: Priestley House Pilgrimage **Bus Stop**
1:30-4:00 110: Computation in the Curriculum, hands-on session **Langone 302**
1:15-5:15 114: Chemistry in Microscale: **Bio Lab 112-114**
1:15-5:15 116: Microscale in General Chemistry **Rooke 335, Organic Lab**
1:30-4:30 118: Modern Methods of IR Spectroscopy. **Olin Lab 274**
1:15-4:15 120: Superconductors, etc **Olin Lab 271**
1:00-3:00 131: Keeping Your Apple in Use **Olin Lab 261**
3:00-5:00 131: Keeping Your Apple in Use **Olin Lab 261**
3:30-5:00 133: Ideas for How High School Students Can Enhance the Elementary Science Classroom. **Bio Lab 115**
1:15-4:15 135: Polymers: A Vehicle of Instruction. **Bio 101**
1:00-4:00 137: Numerical Methods in Physical Chemistry Using MATHCAD. Hands-on. **Rooke 9, Mac Lab**
1:00-3:00 139: Advanced Labs for Second Year High School Chemistry Students. **Bio Lab 115**

Thursday Morning

9:15-12:15 100: Priestley House Pilgrimage **Bus Stop**
9:15-12:15 113: Hands-on Polymer Experiments and Demonstrations. **Bio Lab 105**
9:30-10:30 122: Strength of Materials. **Dana 5A**
11:00-12:00 122: Strength of Materials. **Dana 5A**
9:00-4:00 126: Search CAS On-Line by Structure. **Library Mac Lab**
9:00-1:00 127: Research In Chemistry Education. **Bio 101, 102 and 104**

NOTES

Keynote Address *Sunday Evening*

P-1 HARD CHOICES AND TESTED OPTIONS: THE HISTORICAL EXAMPLES AND HANDS-ON EXPERIMENTS IN ACS'S NEW SMITHSONIAN EXHIBIT. Ned D. Heindel, ACS President, Lehigh University, Bethlehem, PA 18015

Nearly five years in planning and testing, the ACS's new $5.3 million, 13,000 sq. ft. exhibit at the National Museum of American History opened April 27, 1994 to a large crowd of interested visitors. As Scientific Adviser to the exhibit, this author participated in the hard choices of narrowing nearly 5000 artifacts, photos, and graphics down to the 1500 included in the show. Nylon is "in" big but celluloid is barely mentioned. The oral contraceptive pill is covered but phenobarb isn't. Equally hard choices were made in selecting the experiments in the Hands-On Science Laboratory included in the exhibit. Exhibits and experiments were visitor-tested and refined with kids from 6 to 96. Curricular outreach materials were created, financed and field-tested under a separate grant to the Smithsonian from Occidental Chemical. This lecture covers the show's contents and outlines reasons for the choices in both artifacts and experiments.

Plenary Address *Monday Morning*

P-2 JOSEPH PRIESTLEY COMES TO AMERICA. Derek A. Davenport, Department of Chemistry, Purdue University, 1393 Brown Building, West Lafayette, Indiana 47907-1393.

Joseph Priestley (1733-1804) first contemplated emigration to America in 1772 but it was many turbulent years later in 1794 that at the age of sixty he was to set foot in that 'new-found-land'. His most productive scientific years were long past and the increasingly acrimonious, even dangerous, religious and political (the two could scarce be separated) controversies had taken their toll on his normally Panglossian temperament. He hoped that life on the expanding American frontier would provide serenity for his wife Mary and himself and a lack of temptation for their sons. In neither case were his hopes realized. Mary and his favorite son Harry were both to die, the planned pantisocratic community on the banks of the Susquehanna was not to materialize and the intellectual isolation and political and religious ostracism were to prove little better than in England. He did manage to re-establish his laboratory in Northumberland but his scientific publications were now largely devoted to a lonely and increasingly futile defense of the theory of phlogiston. The rising of the Jeffersonian sun in 1800, however, was to warm his final years and he died as he had so often lived, correcting proof of the latest religious tract.

Of Mice & Men & The Isolation of Oxygen, T. Schwartz, Organizer

1-1 THE CHEMISTRY OF AN "HONEST HERETIC." A. Truman Schwartz, Macalester College, Saint Paul, MN 55105.

Joseph Priestley was a prolific polymath who produced a vast corpus of works on theology, history, government, rhetoric, education, law, and chemistry. A Unitarian cleric, his scientific work was an avocation pursued with an amateur's zest and enthusiasm. He isolated, though perhaps did not "discover," at least ten gases, the most notable of which he called "dephlogisticated air." In Lavoisier's laboratory, this gas, formed by heating the red calx of mercury, became oxygène, the life's breath of the new chemistry. This paper will explore Priestley's chemical contributions and speculate on the reasons why this radical thinker refused to accept the chemical revolution he helped launch.

1-2 PRIESTLEY AND FRANKLIN: AN ELECTRICAL DIALOGUE. David J. Rhees, The Bakken Library and Museum of Electricity in Life, 3537 Zenith Ave. So., Minneapolis, MN 55416.

Joseph Priestley's earliest original scientific investigations were made in the field of electricity and were greatly aided by his friend Benjamin Franklin. Franklin encouraged him in the writing of The History and Present State of Electricity (1767), which contains the first published description of Franklin's famous kite experiment. Franklin also helped Priestley gain election to the Royal Society in hopes of increasing sales of his book. Their friendship was such that Franklin spent his last day in England with Priestley, selecting newpaper articles which might be used to win sympathy for the cause of the incipient American revolution.

This paper examines Priestley's personal and scientific relationship with Franklin. It is written in the form of a dramatic dialogue suitable for being performed in classrooms and science museums.

1-3 'THE SAME SUMMER, AND THE SAME SUN': PRIESTLEY, INGENHOUSZ AND THE ELUCIDATION OF PHOTOSYNTHESIS, 1771-1787. Jeffrey L. Sturchio, Merck & Co., Inc., Whitehouse Station, NJ 08889-0100.

Priority disputes have long been standard fare in the annals of scientific discovery. The history of photosynthesis is no exception. Both Joseph Priestley and Jan Ingenhousz have been credited with first recognizing the role of light in the "melioration" of vitiated air by green plants. Priestley first experimented with plant respiration in 1771, only gradually realizing that light was crucial to the production of pure air by plants confined in glass cylinders. Ingenhousz felt that Priestley had not realized the agency of light until after reading his Experiments upon Vegetables (1779). In a letter to Ingenhousz (1787), Priestley conceded that his colleague had published first, asserted that their work had proceeded independently, and noted that "the same summer, and the same sun, operated for us both." Yet neither Priestley nor Ingenhousz "discovered" photosynthesis as we understand it: the roles of carbon dioxide and carbon assimilation were later clarified by two Swiss naturalists, Jean Senebier and N.T. de Saussure. This paper reviews late 18th-century work on photosynthesis--stressing that the discovery was a process, not an event--and places the early investigations of Priestley and Ingenhousz in their intellectual and social contexts.

1-4 FACTITIOUS AIRS AND FRACTIOUS DISCOVERIES. W. B. Jensen, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221.

Joseph Priestley is generally considered to be the pneumatic chemist par excellence. His three-volume work, *Experiments and Observations on Different Kinds of Airs*, records his independent discovery of more than ten new gases. Yet Priestley's productivity also raises the perennial question of what it means to discover a new substance. Not only were several of these gases independently reported by Priestley's contemporary, the Swedish Apothecary, Carl Wilhelm Scheele, many had been prepared a century earlier by the Flemish iatrochemist, Johann Baptista van Helmont. How important is isolation versus preparation in a priority claim? How important is the discover's own understanding of the nature of his discovery? How important is the context provided for the discovery by contemporary theory and laboratory practice? These and other questions will be addressed using not only Priestley's work, but that of several of his predecessors and successors.

4A-1 INDUSTRIAL RESEARCH AND DEVELOPMENT SUMMER INTERNSHIP PROGRAM FOR SCIENCE TEACHERS. Richard J. Sunberg and Ted J. Logan, The Procter & Gamble Company, Miami Valley Laboratories, P.O. Box 398707, Cincinnati, Ohio, 45239-8707.

In 1989, a program was started at Procter & Gamble's Miami Valley Labs to offer opportunities for science teachers to spend their summers working with researchers. As part of an industrial/academic partnership, six science teachers have experienced real life applications of science. Seven other local industries, including Armco, Inc., DuBois Chemicals, and Marion Merrell Dow, Inc., have joined P&G in this effort as an extension of the Partners for Terrific Science program offered by Miami University, Oxford, Ohio. The program was designed to bring into better alignment the classroom experience with the skills and training needed by industry. The program goal is to provide science teachers the opportunity to use their industrial-based chemistry summer experience to create science activities that students find relevant, exciting, and interesting and to help provide the teachers with the answers to those, "Why do we need to know this?" questions.

4A-2 REALITY BASED EDUCATION: *PARTNERS FOR TERRIFIC SCIENCE'S* INDUSTRIAL INTERNSHIP PROGRAM, Sandra Van Natta, White Oak Middle School, 3130 Jessup Rd., Cincinnati, OH 45239; Richard French, Center for Chemical Education, Miami University Middletown, 4200 East University Blvd., Middletown, OH 45042.

In the future, we as a society must operate at a higher technical level, learn new skills quickly, and keep in touch with advances in technology. Teaching our children to do this is not easy. One of the best allies any teacher can have is an interested and involved science professional from a local industrial "partner." The Industrial Internship Program is a new and growing division of the expanding *Partners for Terrific Science* Program at Miami University Middletown. Teachers of all grade levels are revitalized while working as active members of research teams at local industries. Interestingly, the industrial workers also report being revitalized. During the six to ten week summer internship, teachers also update their scientific knowledge while learning the skills needed by today's workforce. As a result of this experience, key lines of communication are opened between industrial and educational communities. Miami University personnel aid the teacher-interns in converting their summer work experience into hands-on, minds-on classroom activities which can be integrated into their existing curriculum. The workings of this program will be discussed.

4A-3 THE U.S. DEPARTMENT OF ENERGY'S TEACHER RESEARCH ASSOCIATES (TRAC) PROGRAM. J. Melcher, Associated Western Universities, Inc., 4190 S. Highland Drive, Salt Lake City, Utah 84124.

The U.S. Department of Energy (DOE)'s TRAC program, begun in 1989, provides outstanding middle and high school science, math, and technology teachers with an opportunity for research participation at DOE laboratories, research facilities, and energy technology centers. Program goals include providing participants with a professional research experience, increasing teacher awareness of current science and technology, enhancing teacher leadership skills, and promoting transfer of new knowledge to the classroom. The TRAC appointment is for eight weeks during the summer; 80% of participants' time is devoted to research, with the remainder spent in related activities such as seminars, field trips, or sessions designed to help them develop classroom transfer plans. In 1993, 337 participants conducted research at 28 DOE facilities. Benefits reported by TRAC participants include firsthand knowledge and information about the process and applications of scientific research; increased credibility and confidence in the classroom; and transfer of their new knowledge to students and colleagues.

4A-4 PROJECT GEMMA: A SUMMER MENTORSHIP PROGRAM FOR THE IMPROVEMENT OF SECONDARY MATH AND SCIENCE EDUCATION. H. L. Paige, Wright Laboratory, Wright-Patterson AFB OH 45433; A. M. Farrell, Wright State Univ., Dayton, OH 45435; S. F. Rinehart, Alliance for Education, Dayton, OH 45423.

Project GEMMA (Growth in Education though a Mathematical/Science Mentorship Alliance) is a cooperative program between education, business, industry, and government, now in its fifth year. Teachers spend six to ten weeks in paid summer work experiences, learning about applications of math and science in the workplace by participating in normal operations at the host facility. In addition, they work individually and in seminar groups on very specific lesson plans that will introduce their students, and the students of colleagues, to the applications that they observed in their work. This talk will start with an overview of the program with some details of its organization. Typical work assignments will be discussed and the observed outcomes, both changes in teacher practices and some tangible items, will be presented.

Overview of Computer Use in Chemical Education: High School and General Chemistry, D. Rosenthal, Organizer

Monday Morning

17A-1 VISUALIZING ATOMS AND MOLECULES IN HIGH SCHOOL. Barry E. Rowe, NCSA ChemViz Group, National Center for SuperComputing Applications, Champaign, IL 61820

Usually, high school Chemistry students adopt the most sophisticated model of the atom and of molecules that they can visualize. Sadly, in most cases this is the so-called 'Bohr atom'. This problem can be addressed and student understanding of bonding can be greatly enhanced by the use of images to illustrate atomic and molecular orbitals. But these images need to be based on more than artists' interpretations of chemists' understanding of abstract concepts. High Powered Computing and Communications can be used by high school teachers and students to make images and animations that give students a better model that is more sophisticated and useful to the young chemist and future citizen. The ChemViz project helps teachers and students better visualize atoms and molecules using custom software and Cray supercomputer time. The ChemViz software will be demonstrated and student generated images and presentations shown.

17A-2 INTEGRATING COMPUTERS INTO THE HIGH SCHOOL CHEMISTRY CLASSROOM. William J. Sondgerath, Harrison High School, 5701 N 50 W, West Lafayette, IN 47906.

A variety of uses for computers in high school chemistry will be presented. The effective use of tutorials with sample quidelines that have been successfully used for specific concepts will be shared. For more valuable sciencing spreadsheets using class data and calculations will be illustrated, along with graphing of data to enhance concept visualization. The data base capabilities of KC? Discoverer in teaching periodicity will be given. Concept stories produced on IBM Storyboard Plus which are shown on liquid crystal display will be shown. The Personal Science Laboratory interfacing value and uses will be shared. The use of Microsoft Works for classroom management and safety will be illustrated. The usefulness of Excelsior's gradebook will be demonstrated.

17A-3 USING INTERACTIVE MOLECULAR VISUALIZATION AND MULTIMEDIA COURSEWARE TO TEACH GENERAL CHEMISTRY. Loretta L. Jones and Clark L. Fields, Dept. of Chemistry and Biochemistry, University of Northern Colorado, Greeley, CO 80639.

Multimedia and molecular visualization computer programs are used in general chemistry courses to provide a comprehensive interactive learning environment. These programs help students visualize molecular structure, view chemical phenomena and applications, and obtain individual feedback on their learning. The design of this implementation is based on learning theories that support the importance of active involvement in learning and the use of technology to address diverse learning styles.

In general chemistry courses at the University of Northern Colorado lectures, homework assignments and laboratory exercises all involve the use of information technology, allowing the content of the course to be expanded, enhancing learning, and allowing better use of instructor time. Multimedia chemistry lessons using video images stored on either videodiscs or CD-ROM allow students to safely investigate a wide variety of chemical systems. The technology also allows students to perform more experiments than possible in a laboratory setting alone and to interact with course content while conducting experiments. Molecular modeling software allows students to visualize molecular shapes and to explore properties such as electronegativity and atomic radius. Computer simulations turn lecture halls into interactive environments.

17A-4 COMPUTERS IN CHEMISTRY AT WISCONSIN. John W. Moore, Department of Chemistry, University of Wisconsin-Madison, Madison, WI 53706.

Computers, software, and multimedia have been integrated into the general chemistry course and throughout our undergraduate program. In addition to conventional drill and tutorial software, we are using artificial-intelligence tutoring programs, spreadsheets, electronic mail, multimedia databases, animations of processes such as crystal cleavage and dissolution, simulations of scientific experiments, environmental research-design and decision-making simulations, simulations of the historical development of chemical ideas, programs that generate data and help students analyze it, molecular modeling systems, and software/hardware for computerized collection and analysis of laboratory data and contol of laboratory instruments. On behalf of a large number of colleagues I will describe and demonstrate typical examples of many of these types of computer use.

Increasing the Use of Writing in Chemistry Courses, H. Beall, Organizer *Monday Morning*

38A-1 RECENT GROWTH OF WRITING IN CHEMISTRY TEACHING. Herbert Beall, Department of Chemistry, Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA 01609

Chemistry is among the subjects included in the writing-across-the-curriculum movement. Although sometimes viewed as calculational, the practice of chemistry is writing-intensive and the importance of using writing in chemistry teaching has always been recognized. The writing used in chemistry teaching, however, has mainly taught the student how writing is done in the discipline. Examples are laboratory reports, reports of literature searches, lecture summaries, journal-style papers and descriptions of problem solving methods. More personal and reflective writing, which is unlike the formal writing of the discipline, has been called "expressive." Expressive writing in chemistry is seeing increased use and includes informal or in-class writing, essays on the student's relationship to the subject, writing for suggestion boxes, and student journals. This kind of writing aids the student's intellectual development in chemistry since it introduces viewpoints beyond algorithms and definitions.

38A-2 WRITING IN CHEMISTRY COURSES George F. Atkinson, Department of Chemistry, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1

Most chemists work in organizational structures which make excellent communication skills a necessity. A number of activities of graduated chemists which involve writing are outlined, such as proposals for purchasing equipment, applications for funds, instructions for staff, resolution of conflicting observations or data, and analysis of problems presented to the lab. Selected experiences with simulations or proxies for such activities within the undergraduate program are presented. These include term papers, time-constrained library exercises and less common forms of lab reports and examination questions.

38A-3 WRITING IN THE UNDERGRADUATE LABORATORY. R. A. Bailey, Department of Chemistry, Rensselaer Polytechnic Institute, Troy, NY 12180-3590

Ways in which laboratory report writing can be used to improve students written communication skills will be discussed. These will include experiences with laboratory reports based on professional journal style, on semi-popular style, and group reports. The value of rewriting and of assistance from writing professionals will be illustrated.

38A-4 USING WRITING TO FOSTER INTELLECTUAL GROWTH. David C. Finster, Department of Chemistry, Wittenberg University, Springfield, OH 45501

The writing-across-the-curriculum movement has started to find its way into many college classrooms in the past decade. However, to simply take a writing assignment and "add and stir" into a course without a sense of the purpose and challenge of such an assignment usually leads to a temporary, unsuccessful venture. This paper will discuss rationales for writing from the viewpoint of intellectual development theory and learning typologies and also present both small (incremental) and large (revolutionary) assignments that can be used in many classrooms. Risks, benefits, advantages and disadvantages will be discussed.

Teaching My Favorite Topic, E. Pulliam, R. Perkins, F. Cardulla, Organizers *Monday Morning*

41A-1 QUALITATIVE REACTION KINETICS, K. J. Spengler, Science Department Palatine High School, 1111 N. Rohlwing Road, Palatine, Illinois 60067

Although a thorough understanding of reaction kinetics requires sophisticated mathematics, the underlying principles can be introduced through simple qualitative analogies. This approach alone may be adequate in a course for nonmajors. It can also serve as a foundation for further study in greater depth. The logic underlying these analogies can help to convince students of the usefulness of the particle model of matter.

41A-2 SYNTHESIS OF A KEY INTERMEDIATE IN THE ORIGINS OF LIFE: HCN. R. Navarro-González*, E. Marambio-Dennett** and S. Castillo-Rojas*. *Instituto de Ciencias Nucleares and **Facultad de Química. Universidad Nacional Autónoma de México. A. Postal 70-543, México D.F. 04510, México.

Educators interested in including the topic of origins of life in their courses have had limited possibilities to imitate the conditions of the primitive Earth, and to show some of the chemical processes that led to the emergence of life. We present a very simple, inexpensive and harmless experiment to illustrate the prebiotic synthesis of hydrogen cyanide in a plasma generated by a Tesla coil in a pseudo "primitive" atmosphere. HCN, considered a key intermediate in the origins of life, can be identified and quantified by standard tests or by synthesizing glycine according to the Strecker reaction, a typical prebiotic reaction. With this simple experiment, it is possible to estimate the rate of production of HCN in plasma environments of the primitive Earth, such as those produced by lightning in thunderstorms and volcanic eruptions as well as those produced by cometary and meteoritic impacts into the atmosphere.

41A-3 SPARKING THE IMAGINATION WITH ELECTROCHEMISTRY, James L. Ealy, Jr., The Peddie School, Hightstown, NJ 08520

Electrochemistry, often overlooked, can be used to extend many principles in chemical education. This presentation will show how to visibly demonstrate the difference between alternating and direct currents with diodes, batteries and electrochemical cells. Participants will be shown how an electrochemical cell using only a nail, NaCl, and metal salts in solution can be used as an easy observational device for the first day of class. This same "experiment" can be used over and over just by adding new dimensions as the course progresses. Participants will also be shown how to modify this very inexpensive setup and how to use it as a continuing research project or laboratory experiment for almost every concept taught in the tradition chemistry course.

41A-4 ANCIENT RIDDLES, MODERN METHODS: USING ARCHAEOLOGY IN TEACHING CHEMISTRY. Ann E. Sheffield, Department of Chemistry, Allegheny College, Meadville, PA 16335

At Allegheny, non-science majors must complete a science requirement that includes two introductory courses followed by a higher-level "capstone" course. The capstone, among other goals, is explicitly intended to help students "understand the interrelationship between science and other areas of life and study". Designing a capstone course gave the instructor the opportunity to combine her training in analytical chemistry with a lifelong love of archaeology. The course is structured as a series of modules. Each module focuses on a paper from the scientific literature dealing with a specific archaeological problem. First, the chemical principles or techniques needed to understand the article are discussed. Next, a cultural context for the paper is created: when and where did these people live? What can be learned about them using chemistry? The paper is analyzed in detail, and, finally, a laboratory experiment based on the module material is performed. The course has proved challenging and fun for students and allows the professor to devote a semester to her favorite area of chemistry.

41A-5 MODELING ORGANIC COMPOUNDS. Preston T. Hayes, Glenbrook South High School, 4000 Lake Ave., Glenview, IL 60025

After two days of introductory nomenclature involving hydrocarbons (both aliphatics and aromatics) and their derivatives, students are given a list of 25-30 selected hydrocarbons, alcohols, ethers, aldehydes, ketones, esters, carboxylic acids, and amines and asked to make molecular ball-and-stick models of each. On completion of each model, students name the completed model, identify the functional group, and then bring the model to the instructor, who announces its name and initials the student handout. Students mingle freely during the construction phase and consult each other about the models. When students have a completely initialed handout, they receive credit for the assignment.

41A-6 TRANSITION ELEMENT CHEMISTRY. C.CHAMBERS, Bolton School, Bolton BL1 4PA, England.

An introduction to transition element chemistry has long been an integral part of chemistry courses in the United Kingdom for students aged 16 to 19. Transition elements exhibit a wide range of chemical properties. A study of selected elements from the first transition series helps students to develop an understanding of catalytic activity, variable oxidation states, the formation of coloured complexes and co-ordination number. The effect of substituting water ligands by other simple molecules or ions can be related to co-ordination number, shape and redox potential. Students learn to apply their knowledge and gain confidence when their deductions can be tested by experiment. Laboratory, industrial and medical applications of transition element complexes enable students to appreciate the importance of this study.

Can We Have a Single Coherent Picture of the Chemical Bond? *Monday Morning*
H. B. Thompson, Organizer

42A-1 THE ELECTRON DOMAIN MODEL: AN ALTERNATIVE APPROACH TO THE CHEMICAL BOND FOR GENERAL CHEMISTRY. R.J. Gillespie, Department of Chemistry, McMaster University, Hamilton, Ontario, Canada, L8S 4M1.

Electron configurations and the chemical bond are conventionally taught in terms of atomic orbitals whose properties such as energy and shape are specified by a set of quantum numbers that arise from the solutions of the Schrodinger equation for a hydrogen-like atom. Because students in introductory courses do not have the mathematical background to understand the Schrodinger equation and its solutions, or the limitations of the hydrogen-like orbital approach, they gain only a very limited and often inaccurate understanding of atomic orbitals and the associated concepts of bonding - they are forced to substitute memorization for understanding. In this paper I present an alternative approach - the electron domain model. This model leads to a simple, but quantum mechanically sound description of the covalent bond that goes beyond the simple Lewis model and leads easily and directly to the VSEPR model. it provides the student with a sound basis for understanding the orbital model and hybrid orbitals if and when these are presented later.

42A-2 THE CHARMING AND USEFUL UNREALITY OF MOLECULAR ORBITALS. H. Bradford Thompson, Gustavus Adolphus College, Saint Peter, MN 56082

The Lewis-type electron-pair model is excellent starting point for discussion of chemical bonding. In molecular-orbital terms, electron pairs in Lewis and VSEPR models occupy localized molecular orbitals (LMO's). LMO's are just as legitimate a molecular description as the "canonical" delocalized orbitals (CMO's) produced by quantum-mechanical calculations. Neither the CMO's nor the LMO's are themselves a proper description of the electronic state — either must be "antisymmetrized" to satisfy the Pauli Exclusion Principle, and *the same antisymmetrized function results starting from either set!* Thus the LMO's are a legitimate starting point for the understanding of bonding. A simple first-year presentation based on localized electron pictures can thus form a basis for full and sophisticated treatments in later courses. The Discussion of hybridization and sigma-pi descriptions in these terms will be presented. Prediction of CMO symmetries given LMO's from Lewis theory will be reviewed. Suggestions will be made for affordable computer programs that students can manipulate to explore hybridization and LMO bond formation.

42A-3 MODELS OF CHEMICAL BONDING. J. F. Harrison, Department of Chemistry, Michigan State University, East Lansing, MI 48824-1322.

One of the early expectations of quantum mechanics was that it would provide the means by which one could elucidate the nature of the chemical bond. Toward this end two competing models evolved, the valence - bond or VB model of Pauling and the molecular orbital or MO method of Mulliken and Hund. The VB model takes a local view of electronic structure and emphasizes bonds while the MO model takes a more delocalized view and emphasizes molecular symmetry. Over the years the MO model became favored by theoretical chemists because of the ease with which it could be used in calculations. Indeed, today, the MO model is used to calculate the properties of molecules with a remarkable accuracy. Unfortunately, extracting properties of individual bonds or describing the bonding in polyatomic molecules using the MO model is as unwieldy and convoluted as ever. The method is much more appropriate to the description of molecular spectroscopy than molecular structure.

I believe the VB method, coupled with the Lewis dot structure provides a powerful and theoretically sound alternative which permits students to gain insight into molecular bonding and structure. In this talk I will describe this hybrid approach and discuss its strengths and weaknesses.

42A-4 ELECTRON DENSITY MODELS OF MOLECULAR STRUCTURE: Gwendolyn P. Shusterman and Alan J. Shusterman; Department of Chemistry, Portland State University, Portland. OR 97207. Department of Chemistry, Reed College, Portland, OR 97202.

Computers can be used to calculate high-quality models for many interesting molecules and the electron density distribution in these models can be conveniently displayed using computer graphics. The electron distribution offers a particularly simple and effective means for introducing students to molecular and electronic structure concepts. Interestingly, inspection of electron density distributions reveals that many of the features that chemists traditionally use to describe molecules (atoms, bonds and orbitals) appear to be absent! The general features of electron density models and their application in the general chemistry course, along with new methods for describing atoms and bonds, will be presented.

54-1 CORPORATE EXPECTATIONS OF LABORATORY TECHNICIANS AND PLANT OPERATORS IN THE NEW CHEMICAL INDUSTRY. Patrick Jackson, Department of Human Resources, Ciba-Geigy Corporation, 444 Saw Mill River Road, Ardsley, NY 10501

Performance expectations of laboratory technicians and plant operators are increasing at a very rapid rate and their assignments are broadening rapidly. These paradigm shifts will be described with a view to the changes in educational preparation that are needed.

54-2 AN INDUSTRY RESPONSE TO TRAINING THE NEEDS OF CHEMICAL PLANT OPERATORS. Jennie Bush, Chemical Manufacturers Association, 2501 M Street, NW, Washington, DC 20037

The chemical industry is finding that chemical plant operators must be much better prepared than in the very recent past. One result is training programs that respond to the demand for higher academic levels as well as broader training to respond to the changing characteristics of the work place.

54-3 A TECHNICIAN'S CAREER IN A CHANGING CHEMICAL INDUSTRY. Anthony Vecere, OSI Specialty Chemicals, Old Saw Mill Road, Tarrytown, NY 10591

Twenty years in the chemical industry has seen this technician's career span assignments from organic synthesis with associated analytical work to increasing responsibility contact with customers and production activities to technical service that converts raw materials to end uses. Ensuring that new technicians are well prepared for similar diversity is a duty of schools, colleges, employers, and the individual technicians themselves. From the perspective of an industrial technician's career experiences, recommendations will be presented on the actions these various institutions should take to develop the strongest possible workforce.

54-4 PROFESSIONALISM, A CHEMICAL TECHNICIAN'S TRADEMARK. Russell Kellum, Technician, Colgate Palmolive Company, 909 River Road, P.O. Box 1343, Piscataway, NJ 08855-1343

Over a period of 25 years, "advanced" chemical technicians have moved from being pairs of skilled hands directed by chemists to laboratory partners recognized for problem solving ability and decision-making as much as for skill in chemical analysis, development, and synthesis. This modern role for technicians demands more education, improved skills, and a different attitude toward work and responsibility in the work place. This modern role fulfills all the demands implicit in the term "professional." ACS has recognized this change by supporting the development of the Division of Chemical Technicians and related activities. The presentation will describe ways in which technicians, employers, and educators can work together to ensure that technicians are prepared for this modern role.

54-5 A TENTATIVE RESPONSE TO STANDARDS, INDIVIDUAL CAREER ASPIRATIONS, AND CHEMICAL INDUSTRY NEEDS. Kenneth Chapman, Head, Technician Resources/Education, American Chemical Society, Washington, DC 20036

Voluntary industry standards, Project 2061, national science education standards, SCANS, and other recommendations all have contributions to make in the improvement of the nation's workforce of technicians and operators for the chemical industry and related areas. Melding the advice expressed by this panoply of reports into a coherent education program is a challenge that must be met. Suggestions about designing curricula and changing instructional paradigms will be presented with a strong emphasis on the secondary school.

Chemical Research Opportunities for Secondary School Faculty *Monday Afternoon*
S. Van Natta, R. French, Organizers

4B-1 BP OIL/BP CHEMICALS TEACHER IN RESIDENCE PROGRAM. J.E.Gilbert, BP Oil/BP Chemicals, 1150 South Metcalf, Lima, Ohio 45804.

BP Oil Lima Refinery and BP Chemicals Lima Plant established a BP Teacher in Residence program in 1992. THe teacher spends a year working at the two plants coordinating the company's educational initiatives. A major focus of the residency is a science partnership with area schools, a program which reached over 13,000 students in 1993. The teacher also develops curriculum materials to help transfer science in industry to the classroom. This presentation describes the BP Teacher in Residence program including objectives, selection, operation, and benefits to education and industry.

4B-2 PARTNERS IN SCIENCE. M. L. Grayeski, Research Corporation, 101 N. Wilmot Road, Suite 250, Tucson, Arizona 85711-3332

Partners In Science was developed by Research Corporation in 1988 to provide academic summer research experiences for high school science teachers. The program was founded on several premises: 1) the high school teacher must be involved in research which is scientifically significant and with faculty whose work is recognized either by refereed publications or research grants; 2) the partnerships should be local in nature to encourage academic year interactions; 3) partnerships should extend over two summers to fully develop the high school teacher's research and encourage maximum classroom spinoff; 4) teachers are provided with small amounts of funding for academic year enrichment; and 5) an annual conference enables the teachers to share their experience and develop new contacts with other teachers. Since the program was initiated in 1988, two hundred forty teachers have participated in 14 states through collaborative ventures between Research Corporation and a number of private foundations and corporations.

4B-3 RESEARCH INTERNSHIPS FOR K-12 TEACHERS: WHAT MAKES FOR SUCCESS? WHAT IS SUCCESS?

Susan K. Henderson, Research Explorations for Teachers, Continuing Education and Extension, University of Minnesota, Minneapolis, MN 55455.

Research Explorations (REX) for Teachers places K-12 teachers in relatively short summer internships in ongoing research projects of University of Minnesota science (including chemistry) and social science faculty. Teachers select which project they want from a list of program-approved projects. REX seminars interspersed throughout the summer and following academic year prepare teachers for their research experience and assist them in translating their experience into curricular material for use in their own classrooms. REX seeks to improve elementary and secondary education by providing updated science information and insights into the nature of inquiry; fostering inquiry-based, open-ended teaching in K-12 classrooms; and renewing teachers' enthusiasm for teaching.

4B-4 THE MASTER OF ARTS DEGREE - OPPORTUNITIES FOR HIGH SCHOOL TEACHERS.

Gretchen M. Rehberg, Department of Chemistry, Bucknell University, Lewisburg, PA 17837

Bucknell University has recently started a program for high school chemistry teachers designed to culminate with a written thesis for a Master of Arts Degree. This three to four summer program emphasizes research as the primary mechanism for learning. The program provides some summer support for a limited number of teachers, involves course work in the major subdisciplines of chemistry and puts the teacher in a research lab with their faculty mentor. It is expected that the research done will lead to a publishable thesis.

4B-5 THE LOS ALAMOS NATIONAL LABORATORY APPOINTMENT, DOE/TRAC.

Marie Reluga, East Catholic High School, Manchester, CT 06040-1898

A high school chemistry teacher will share first hand her experience of a 1993 summer research experience.

4B-6 ...AND "WHAT DID YOU DO DURING YOUR SUMMER VACATION, GWEN?"

M.G. Sibert, Roanoke Valley Governor's School for Science and Technology, 2104 Grandin Road, SW, Roanoke, Virginia 24015

High school chemistry teachers too often have had little or no research experience, especially if they have been teaching for a number of years. The ACS encourages academic and industrial research experience for secondary chemistry teachers and there are organizations in the scientific world, such as NSF and ASBMB, that provide research opportunities for teachers during the summer months, but how does one go about finding such opportunities? The experience of one high school chemistry teacher in finding out about and obtaining funding for summer research will be presented.

17B-1 COMPUTATIONAL CHEMISTRY AS A KEY TOOL TO TEACH ORGANIC CHEMISTRY.
Joseph Casanova, Department of Chemistry and Biochemistry, California State University, Los Angeles, Los Angeles, CA 90032

The use of computer-based molecular modeling to teach molecular geometry and structure in chemistry, especially in organic chemistry, is growing rapidly. Yet before many of our colleagues become aware of the magnitude and consequences of that change, a second change is underway. That change involves our ability to calculate electronic structure easily and quickly at high levels of theory, and is permitting us to teach chemical behavior through electronic structure derived from computer-based modeling. Software to accomplish this is already available. The ability of chemists with limited training in the theoretical underpinnings of quantum mechanical calculations to use these calculations to advantage and readily gain insight into electronic as well as geometric structure is permitting us to introduce students to concepts such as resonance, polarity, hybridization, and reactivity patterns from first principles, as a natural consequence of molecular electronic structure rather than as obtuse formalisms. This paper will explore some current uses of the use of computational chemistry in the classroom and is designed to stimulate discussion of direction in the introduction of higher level computational chemistry into the curriculum - the early stages of routine use of theory to predict structure and chemical behavior for classroom use from computer-based methods.

17B-2 SELF-PACED ORGANIC CHEMISTRY. Stanley Smith, Department of Chemistry, University of Illinois, Urbana, IL 61801

Computer-based instructional programs have been used as a required part of introductory organic chemistry lecture and laboratory courses at the University of Illinois for over 20 years. The current computer system uses microcomputers connected to a server which is accessible from several campus sites. Work completed by students is automatically recorded and records are available to instructors in on-line gradebooks. Students have access to instructional programs on each of the major topics in the first-semester survey organic chemistry course.

17B-3 TEACHING COMPUTER SKILLS, AN ESSENTIAL TOOL FOR All CHEMISTS.
Robert Megargle, Department of Chemistry, Cleveland State University, Cleveland, OH 44115.

The ability to use and exploit the computer is essential for anyone entering the chemical world today. At Cleveland State University, computer applications are taught in several courses. Students take a required course in BASIC programming, where they also learn word processing. They learn automated literature searching techniques in a course on Chemical Information. Spreadsheet tools are introduced in Physical Chemistry Laboratory. They learn instrument interfacing by programming data acquisition and data processing in the first quarter of Instrumental Analysis Laboratory. In the second quarter, the students program a robotic experiment. A course in Electronics for Chemical Instruments is offered as an elective, and it concludes with an experiment where the students wire and program a computer interface to lab bench apparatus.

17B-4 NEW CURRICULUM MODEL USING COOPERATIVE LEARNING AND COMPUTERS IN ANALYTICAL CHEMISTRY COURSES. John C. Wright, Department of Chemistry, University of Wisconsin, Madison, WI 53706

The universal availability of modern spreadsheets has created new opportunities for teaching analytical chemistry in an authentic way because students have sufficient computing power to describe complex chemical systems with the simple equilibrium concepts that are the foundation of the course. In order to accomplish this task, a cooperative learning environment has been created at Wisconsin where teams of students work on open-ended problems with well-defined goals. The students are responsible for designing, implementing, trouble-shooting, and analyzing the entire experiment. In order for this approach to work effectively, it is important to introduce a number of curriculum innovations that empower the individual students as well as the teams to accomplish significant work.

This work was supported by the National Science Foundation under grant NSF 94-50615.

What Will "Textbook" Mean in the Year 2000? *Monday Afternoon*
R. Kerber, Organizer

20-1 ADAPTING A CHEMISTRY TEXTBOOK TO ACCOMPANY A MODULAR APPROACH. D. R. Kimbrough, Department of Chemistry Box 194, University of Colorado at Denver, Denver, Colorado 80217-3364

General Chemistry and Organic Chemistry represent the lion's share of the college-level chemistry textbook market, and in both areas the subjects have expanded such that their texts exemplify information overload. Omitting several of the topics and chapters covered in the textbook has become a necessity rather than an option, and professors begin each semester not deciding what to teach but what to leave out of their courses. The explosion of knowledge in chemistry has paralleled the explosion of technology in the latter half of this century, yet, rather than exploring new methods of imparting information, we just teach from heavier books. Chemistry faculty need to take more responsibility for selecting the topics they present (and they omit) in their courses. Textbook publishers need to explore new methods of custom fitting texts and materials to each professor or course. A modular approach to teaching general and organic chemistry would provide each professor with his or her own personalized course. However teaching such a course with a "traditional" chemistry textbook has proved extremely difficult. Publishers need to explore other options besides 4-color graphics.

20-2 IS THE TEXTBOOK DEAD? John C. Kotz, Chemistry Department, State University of New York, Oneonta, NY 13820

A recent article in Cornell Magazine asked "Is the Textbook Dead?". Chemistry textbooks are not dead, but they are surely changing. This is due in part to the pressures of faculty who want a different approach to the subject and in part to advances in technology. This paper will discuss the impact of technology on textbooks. In chemistry, the greatest impact will come from materials delivered by computers and related technology. For example, the recently published book *The Chemical World* (by Kotz, Joesten, Wood, and Moore) contains end-of-chapter questions that can only be answered using computer programs and videodiscs. Lectures at SUNY-Oneonta have been delivered for two years using computers and feature molecular modeling, and these materials are available to students as a supplement to the textbook. Further, our inorganic chemistry laboratory relies heavily on molecular modeling. And finally, by the year 2000 CD-ROM or other technology may mean that the textbook is a supplement to software, just as even the best software now requires a reference manual. Indeed, we may finally achieve the slim, yet flexible, textbook that many instructors of chemistry seem to want.

20-3

STUDENT EXPECTATIONS FOR COURSE MATERIAL IN THE YEAR 2000

Richard Stratton, Houghton Mifflin Company, Boston, Massachusetts, 02116

In addition to professors' demands for delivery of instructional material in non-print media and the increasing power and affordability of hardware, student expectations are likely to be a contributing factor in shaping "textbooks" over the next five to ten years. Significant changes in the use of technology in the classroom are taking place now on the primary and secondary levels; the potential impact of those changes on post-secondary education will be examined. Also, alterations that have taken place in the make-up of the student population will be considered, along with the implications of those changes for the use of both print and non-print media.

20-4 "PACKAGE OR PERISH: THE PUBLISHER'S CHALLENGE,"

Kent Porter Hamann, D. C. Heath

At present, publishers devote considerable time, money, and resources to developing and manufacturing a complete and ever-expanding range of learning materials on various platforms to accompany their printed textbooks. In the future, with access to new hardware and additional technological advances, the packages will become even more extensive. In fact, we will probably have to define the word "textbook" so that it becomes a term referring to a wide array of electronic and print materials that, together, construct a complete learning environment. We will look at an example of an interactive textbook on CD-ROM in this session and discuss the prospect of new methods of "delivering" information to students in the year 2000.

20-5 THE TEXTBOOK OF THE FUTURE Jennifer Speer, Chem. and Environmental Science Editor, McGraw-Hill Inc., 1221 Ave. of the Americas, New York NY 10020

McGraw-Hill "textbook" publishing has taken on many meanings. In addition to our traditional text publishing program in the college division; there are three groups also addressing market demands.

The "Overture Series" consists of well-known titles that are produced in black and white. They are soft-cover and are not accompanied by expensive supplements packages. These titles address the extremely price conscious. The "College Custom Series" allows professors to take their notes or a combination of their notes and McGraw-Hill materials and create a customized text for their course.

Primis is the first major entry into the electronic publishing field. This database of materials provides professors with a truly innovativeway to customize their course. Not only can a professor customize text material but also available on the system are articles, cases,labs that can all be combined with professors' materials such as: course syllabi, teaching notes,lectures, problems or copyrighted information. Primis is currently developing multi-media to accompany customized texts and ultimately will act as as an on-line database.

20-6 PUBLISHING IN THE TWENTY-FIRST CENTURY. THE ROLE OF NEW TECHNOLOGIES Nedah Rose, Chemistry Editor, John Wiley & Sons, Inc., 605 Third Avenue, New York NY 10158-0012

Computer and video technology offer exciting new possibilities for presentation of chemical principles in ways that will motivate students and enhance their learning. Many educators who are involved in developing computer/video materials advocate their superiority over traditional print materials; some even say that the book will be replaced. But there are fairly serious barriers to widespread use of new technology materials. This presentation will explore some of those barriers as well as describe some of the steps publishers are taking to overcome the barriers and move into the new frontier.

20-7

A NEW APPROACH TO GENERAL CHEMISTRY. Anne Scanlan-Rohrer, Benjamin-Cummings Publishing Co., 390 Bridge Pkwy, Redwood City, CA 94065

Benjamin-Cummings Publishing Company proposes a general chemistry project that would seek to achieve the following goals: 1. To motivate principles through observation by beginning conceptual units with multidimensional problems or analogies which would continue to prompt and augment discussion of principles throughout the unit. 2. To provide the dynamic connections between chemical principles through a multimedia program that would allow students to make logical jumps between related areas, bypassing the confines of the linear printed material. 3. The integrated multimedia program would also serve the visual needs of general chemistry by using technology to perform tasks beyond the realm of the linear textbook: presenting dynamic behavior; providing tools for plotting of data, etc.; providing interactive and/or tutorial problems for homework and review. We are seeking educators to join us in planning this text/media project.

20-8 TEXTBOOK AND TECHNOLOGY: THE FUTURE OF CHEMICAL EDUCATION. C. W. Porter, Department of Chemistry, The University of Akron, Akron, Ohio 44325-3601

In the past, chemistry students have been presented with a time honored method of chemical instruction; textbooks, lecturer and the chalkboard. Unlike our science, with its fast paced and continual striving for new frontiers to explore, chemical education has tended to remain stagnant. Up until now! With the advent of exciting new technology, students are now able to experience the excitement of chemistry. Using computer generated lecture slides, VCR, live demonstrations and computer animations, current and future students are able to "see" chemistry in action. This talk will demonstrate some of the current technology and explore ways of incorporating textbook and technology as partners in advancing chemical concepts.

20-9 MAKING CONNECTIONS AND MAKING DECISIONS: INTERACTIVE MULTIMEDIA SOFTWARE AS A COMPONENT OF FUTURE CHEMISTRY TEXTBOOKS.
T. J. Greenbowe, Department of Chemistry, Iowa State University, Ames, Iowa 50011

Perhaps future chemistry textbooks will be designed differently to accommodate what the print media does best and what multimedia software does best. In the future, color lap-top/notebook computers will include a built-in CD-ROM drive and be as affordable as an advanced scientific calculators. In the future, textbook publishers and editors will be happy (*) to include 5 or 6 CDs with a printed textbook for about the same price as students now are paying for their textbook. Visual images, computer animations of molecules, interactive exercises, and quiz problems for each topic will be available on the CDs. While the student is reading the textbook, the text might direct the student to view still or motion color images accompanied with an optional narration track in three or four languages, work and respond to interactive exercises, run a simulated laboratory experiment, or explore a microworld of a chemical system. Using interactive situations, the software can probe the student for common misconceptions or "alternative frameworks". Students having difficulty understanding a concept will be able to use a mouse to click-on icons and interact with Quick-Time® movies of a "Professor", "TA", and "Peer" offering their unique explanation of the difficult concept or principle. Interactive CD-ROM discs and appropriate multimedia software programs offer students unique opportunities to be active learners. Prototypes of the above mentioned components of a future multimedia CD will be displayed using live computer images or slides and discussed. (* prediction!)

Environmental Chemistry & Environmental Science Programs *Monday Afternoon*
I. Hartman, L. Soltzberg, Organizers

24-1 **AIMS OF A PROGRAM IN ENVIRONMENTAL SCIENCE:** Iclal S. Hartman, Chemistry Department, Simmons College, 300 The Fenway, Boston, MA 02115.

Even as we await the formal recommendations of the American Chemical Society Committee on Professional Training, many of us are already involved in developing or implementing environmental science programs. There is a wide range of career opportunities for well trained environmental scientists in Environmental Protection, Natural Resource Management and Public Administration & Planning. Furthermore, these career paths can be pursued in various sectors, nationally or internationally, from federal, state and local government to industry and other private agencies. We need to think, however, beyond these immediate opportunities, and focus on how our graduates will fit and in what capacity they will function in the larger framework of environmental decision making. Too often the voice of the scientific community is not heard until after decisions are made by non-scientist administrators or legislators. We should strive to educate our students to be more than technical experts. They should be trained for leadership in environmental assessment, prevention, balancing of differing and usually opposing needs, and especially, in the formulation of scientifically sound policies, laws and compliance guidelines. This may mean that we need to consider more inclusive and integrated five to six year programs culminating in the appropriate graduate or a joint degree.

24-2 ENVIRONMENTAL SCIENCE AND PUBLIC IMPACT: VASSAR'S APPROACH. Marianne H. Begemann, Department of Chemistry, Vassar College, Poughkeepsie, NY 12601

At Vassar College, we have just begun to offer a "correlate sequence" (minor) in Environmental Science. Because of its emphasis on intermediate and upper level courses in biology, chemistry and geology, the correlate sequence is designed for majors in these fields, but can be elected by students majoring in other subjects as well. In addition to five courses, one semester of senior year independent research is required to complete the correlate sequence. The rationale for constructing an environmental science correlate sequence which emphasizes the sciences and includes independent research, and why we have decided not to offer a major in environmental science will be presented. A long term multidisciplinary research project which students electing the sequence are encouraged to participate in will be described.

24-3 Students Environmental Awareness and their Understanding of Chemistry Relevant STES Issues

Uri Zoller[1] Yehudit J. Dori[2] and Aviva Lubezky[1]

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Technion, Israel Institute of Technology
Haifa 32000, Israel

Abstract

Environmental education (EE) is targeting at preparing environmentally aware, knowledgeable and motivated citizens, who are willing to act for improving the environmental quality of life based on their relevant value system. This willingness to act is expected to be a result of a continuous purposed educational effort while the capability to act requires a minimal level of disciplinary and interdisciplinary literacy. Until recently, chemistry courses at all levels in Israel rarely include a particular EE emphasis. Several strategies within ongoing courses and specifically designed courses have been implemented in the last few years in an attempt of remediating this state of affairs. We have investigated the EE-oriented entry behavior and the effect of the EE oriented in-service teachers training and/or chemistry teaching on students awareness, understanding and relevant higher-order cognitive skills (HOCS). To this end, we compared two populations,one from the Technion and one from Haifa University-Oranim. One of the Technion groups consisted of pre-service chemistry teachers, studying methods of chemistry teaching in their last academic year, without being formally exposed to science-technology-environment-society (STES) issues in this course. The second Technion group consisted of in-service science teachers who took part in a specially-designed EE training program.The Oranim population consisted of pre-service science teachers, studying general and inorganic chemistry course in their first academic year, without being formally exposed to specific STES issues within this course.The findings, conclusions and their interpretations concerning three pre-post students' awareness, understanding, and relevant HOCS will be presented and discussed in terms of the implications for future action as far as EE within chemistry teaching is concerned.

24-4 ENVIRONMENTAL STUDIES CURRICULA, John A. Gibbs, John Flowers, Department of Physical Sciences and Computer Science and Hiroko Karan School of Science, Health and Technology, Medgar Evers College, City University of New york, 1150 Carroll Street, Brooklyn, NY 11225

Today's society is growing increasingly interested in the scientific basis for concerns and uncertainties about the environment. This is giving new meaning to the term "environmental education".. Universitities and colleges are restructuring degree programs and creating new Departments so as to address the complex cross-disciplinary aspects of the subject matter. This presentation provides some quidelines for the development of "Undergraduate Environmental Science Curricula". In essence, it reflects our experiences in the development of our environmental science program leading to the BS Degree.

24-5 MARINE CHEMISTRY FOR UNDERGRADUATES, Susan Libes, Marine Science Department, Coastal Carolina University, P. O. Box 1954, Conway, SC 29526

Students enrolled in undergraduate marine science degree programs should receive training in the four subdisciplines: marine biology, marine geology, physical oceanography, and marine chemistry. Instruction in the latter has proven difficult due to the lack of an undergraduate textbook. This situation has been remedied by the presenter who is the author of An Introduction to Marine Biogeochemistry published by John Wiley and Sons in 1992. She has taught marine chemistry for 11 years at Coastal Carolina University which has over 400 undergraduate marine science majors. Her presentation will illustrate how the author structures a course and laboratory. The central theme is the role which the ocean plays in material transport and transformations on the planet. The material covered includes the physical and redox chemistry of seawater and sediments as well as the chemistry of marine organisms and organic compounds. This information is used as background for a discussion of marine pollution.

24-6 AN ENVIRONMENTAL ANALYSIS COURSE FOR UNDERGRADUATES. Caryl L. Fish, Saint Vincent College, Latrobe, PA 15650

As part of a degree in Chemistry: Environmental Science, an advanced undergraduate course in environmental analysis has been developed at Saint Vincent College. This course introduces students to sampling techniques, sample preparation, and analysis of air, water, waste material, and soil using a team project approach. Four projects are completed in the semester each one dealing with a different matrix and analysis method. The students analyze air for nitric acid, aqueous waste for organic compounds, soil or sediment for metals, and stream or lake samples for a series of water quality parameters. For each project a team of students is responsible for determining the best approach for their problem, taking appropriate samples, analyzing the samples, and reporting the data. Using this approach students learn the basic techniques of environmental analysis as well as the skills necessary to work as part of a team.

INTRODUCTION OF ENVIRONMENTAL EXPERIMENTS THROUGHOUT THE
24-7 UNDERGRADUATE CHEMISTRY CURRICULUM. Wilmer Stratton and Jeffrey Hansen, Department of Chemistry, Earlham College, Richmond, IN 47374

As part of an increased emphasis on environmental studies in the Earlham chemistry program, we are developing a variety of experiments which we believe enhance the effectiveness of the courses and increase the level of student interest. This talk will describe some of our efforts. In the first year, our science majors begin with an introductory course in environmental chemistry. Lab work in this course includes studies of rain and surface waters. Organic courses include studies of petroleum hydrocarbons in the environment, while Analytical courses feature other trace organics and trace metals in water or other matrices. An upper-level course in Environmental Chemistry includes a more comprehensive study of rain and surface waters, followed by studies of heavy metals and studies of trace organics such as phthalate esters, trihalomethanes, industrial solvents or pesticide residues. Some specific recent projects will be described.

Moving Mountains: Changing the Teaching of Chemistry at Large Universities, J. Keiser, Organizer — *Monday Afternoon*

26-1 THE ONE MINUTE PAPER: A COMMUNICATION TOOL FOR LARGE CLASSES. William S. Harwood, University of Maryland, College Park, Maryland 20742

In a large general chemistry class it is important to generate good communication between students and teacher. Ideally there should be instantaneous feedback between the student and professor. One tool to help improve communication and class attention is the "One Minute Paper." A One Minute Paper given at the end of each lecture has been proposed as a tool to provide active learning in the classroom. This talk will describe and evaluate the technique based on its use in a typical general chemistry class at a major university over the past three years.

26-2 USING INSTANTANEOUS SMALL GROUPS IN LARGE LECTURES: A FIRST STEP TOWARDS A COLLABORATIVE LEARNING ENVIRONMENT‡ Thomas A. Holme, Dept. of Chemistry, University of Wisconsin - Milwaukee, Milwaukee, WI 53201

An adapted use of Socratic questioning suitable for use in lecture halls with 100 to 300 students will be discussed. Rather than asking rhetorical questions which either no students or only the most aggressive ones answer, small groups of students who are sitting physically near one another are required to answer to advance the lecture. This method has several positive impacts: First it enhances active listening among students; second it serves to lessen the depersonalized feel of the large lecture setting and finally it invigorates the teaching experience for the lecturer. Student opinions and outcome based studies will be used to demonstrate the efficacy of this approach.

‡Carried out at the Department of Chemistry, University of South Dakota, Vermillion, SD 57069

26-3 **MOVING MOUNTAINS ONE ROCK AT A TIME: MY EXPERIENCES IN CHANGING GENERAL CHEMISTRY.** John J. Fortman, Dept. of Chemistry, Wright State University, Dayton, OH 45435.

In the Fall of 1992 I began a program with 50 honors students to change general chemistry at Wright State, turning it "upside-down, inside-out, and backwards." The course is designed to educate students about chemistry instead of training all to do chemistry. It is organized around applications instead of principles. It starts with the chemistry of living things (organic & biochemistry), moves to materials, and finishes with energy. In the Fall of 1993 it took the place of one of our regular general chemistry sequences for 100 students. Instead of completely replacing our classical general chemistry sequence it will remain an alternative offering for 1994-95. The successes and difficulties will be presented. The chief obstacles encountered have been transferability and other teachers of general chemistry. To quote Pogo: "We have met the enemy and it is us."

26-4 A REVISED GENERAL CHEMISTRY CURRICULUM WITH AN EMPHASIS ON MODERN APPLICATIONS OF CHEMISTRY. P.M. Owens, R.G. Costella, Department of Chemistry, United States Military Academy, West Point, NY 10996

Chemistry, the molecular science, lies at the heart of several key technologies driving change in our society today. Molecular biology, materials science, and environmental science represent emerging fields that require a fundamental understanding of structure and change at the atomic and molecular level, the essence of chemistry. Unfortunately, conventional general chemistry courses devote little if any attention to these areas, in spite of the fact that students today are very interested in understanding the key principles governing these rapidly advancing fields.

The two semester General Chemistry course at West Point has been revised to address this need. The first two-thirds of the course is spent studying the traditional general chemistry topics that are necessary to understand the chemistry of emerging technologies. The last third of the course is devoted to a study of four major areas: materials science, the chemistry of life, environmental chemistry, and military chemistry. The goal of the course is to provide the students with a literacy in key technologies from which they can make informed decisions as citizens and as leaders.

26-5 THE LANGUAGE OF CHEMISTRY: ORGANIC CHEMISTRY, CASE STUDIES, AND NONSCIENCE MAJORS. Jerrold Meinwald, Cornell University, Department of Chemistry, Ithaca, NY 14853, and Stacey Lowery Bretz, Cornell University, Department of Education, Ithaca, NY 14853.

Many introductory college chemistry courses are notorious for encouraging rote learning; students often leave the course feeling overwhelmed with details, frustrated by meaningless equations memorized for no apparent reason other than to "plug and chug." Such feelings of frustration are often magnified many-fold among nonscience majors.

This paper will describe "The Language of Chemistry," an innovative course designed to circumvent the traditional formula for introductory chemistry classes by using a case-based approach to introduce nonscience majors to the processes that chemists use to understand the chemistry underlying various aspects of life. Through careful examination of a few milestone investigations of naturally occurring, biologically important compounds, the principles of chemistry are developed. Rather than emphasizing the memorization of specific results or formulas, the focus on methods of analysis facilitates developing students' problem-solving skills. The course culminates with students researching and presenting mini-case studies on a wide range of topics of current chemical/medical importance such as taxol, prozac, and positron emission tomography (PET).

26-6 CHANGING THE TEACHING OF CHEMISTRY AT A MEGAVERSITY. John P. Lowe, L. Peter Gold, Robert D. Minard, Joseph T. Keiser, Richard A. Henry, Peter C. Jurs, Department of Chemistry, The Pennsylvania State University, University Park, PA 16802

Penn State, with common chemistry courses offered at nineteen locations to students in over fifty different programs and a system-wide annual general chemistry enrollment of almost four thousand students, represents by the inertia of its sheer size a formidable challenge to change in chemistry teaching. We will discuss the ways in which the process of change has nevertheless been initiated, the achievements so far, and our strategies for achieving more change in the future.

26-7 THE CONTINUITY OF CHEMISTRY : A DEMONSTRATIVE CURRICULUM. Jeff D. Kovac, Fred M. Schell, Fred A. Grimm, and Al A. Hazari, Department of Chemistry, University of Tennessee, Knoxville, TN 37996.

Our NSF curriculum proposal emphasizes the continuity of chemistry. We imagine the curriculum as a highly-structured minimal core embellished with electives. Throughout the curriculum we will emphasize the major themes of characterization of chemical systems and chemical reactions and dynamics. In the lower-division core we intend to teach the material in such a way that it will not have to be retaught in later courses. The laboratory will be thoroughly integrated into the courses with chemicals returned to the center of the curriculum. Modern educational technology will be utilized wherever possible. Our goal is to produce an innovative curriculum which our colleagues around the country will be eager to implement.

26-8 THE NEW CHEMISTRY CURRICULUM AT THE UNIVERSITY OF MICHIGAN. Seyhan N. Ege and Brian P. Coppola, Department of Chemistry, University of Michigan, Ann Arbor, MI 48109-1055.

Chemistry deals with molecular interpretations of phenomena that range from materials to life. Principles of structure and reactivity are the basis for understanding all of these phenomena. These principles should form the basis for introductory chemistry. Large numbers of students now have their first experience with college chemistry in such a course at the University of Michigan. This course uses organic chemistry as the context in which basic concepts of chemistry are introduced. Such a first year course has implications for the rest of the curriculum. How such major change was initiated, and how it continues at the University of Michigan will be discussed.

26-9 CLOSING THE INSTRUCTIONAL GOALS GAP: PROVIDING NEW METAPHORS FOR FACULTY AND STUDENTS. Brian P. Coppola, James Hovick, Joseph Krajcik, Department of Chemistry, School of Education, The University of Michigan, Ann Arbor, Michigan, 48109.

As chemistry instruction moves into an era of large-scale reform, one of the questions we are interested in is whether identifying and addressing fundamental motivational differences between faculty and students can help inform and advise the effort. Five years after the implementation of our revised curriculum, we have interviewed faculty and students from our two different first-term chemistry courses to examine their perceptions about instructional goals, how they are ranked, how they are implemented, and each group's opinions about the goals of the other. A similar interview strategy was also useful during the period of curriculum changeover. The results from the interview work suggest that significant gaps in goals exist, and also some ways that they can be overcome.

26-10

REPLACING THE ONE-FACULTY/ONE-COURSE MODEL OF REFORM: THE DEPARTMENT-BASED AUDIT OF UNDERGRADUATE INSTRUCTION, Sheila Tobias, 724 North Campbell Avenue, Tucson, Arizona 85719.

Revitalizing Undergraduate Science: Why Some Things Work And Most Don't (Research Corporation, 1992) reveals that where undergraduate programs "work," teaching (and not just individual teachers) is the subject of intensive and continual departmental review. Embedded in the distinction between teaching and teachers lies a truly revolutionary idea, namely that the quality of its teaching not just the quality of its teachers has to be measurable and open to department-wide discussion and debate. This means that an innovation model is replaced (or augmented with) a model for managing change.

The department-based "audit" of undergraduate instruction is intended to begin a structured conversation in an academic department around some basic questions: How are we doing? How can we find out how we are doing? How could we do what we are doing better? What is within our existing powers to change? What is outside of our existing powers to change? How do we get the powers we need back into our control? And what can we do to improve our course offerings tomorrow? The point is to make any kind of improvement, the department has to sort out not just what it wants to do, but what is within its powers to accomplish.

Increasing the Use of Writing in Chemistry Courses, *Monday Afternoon*
H. Beall, Organizer

38B-1 WRITING ACROSS THE CURRICULUM: LINKING SCIENCE AND ENGLISH. L. S.. Zarzana, Department of Chemistry, American River College, Sacramento, CA 95841

This presentation will report on the linking of a science class with an English class. The original purpose was to explore the integration of writing into the chemistry curriculum, but an added advantage has been the establishment of learning communities that extended beyond the traditional classroom. A comparison of strategies emphasized in a composition class with those used by scientists will be made, and the advantages and disadvantages of linked classes and learning communities will be discussed.

38B-2 WRITING ACROSS THE CURRICULUM AND FRESHMAN CHEMISTRY

Nancy J. S. Peters & David Cutts, Natural Science Division, L. I. University - Southampton, Southampton, NY 11968

In 1993, Southampton instituted a "Writing Across the Curriculum" (WAC) requirement: students must complete five WAC courses during their undergraduate years in order to graduate. The goal of the WAC program is to foster learning in subject areas through writing as well as to improve writing skills. The freshman chemistry course, Chemistry 101-102, is accepted as a WAC course and has, in fact, had a strong writing component since 1988. The paper will discuss the benefits, difficulties, successes, and changes involved in incorporating writing into a traditional freshman course.

38B-3 USING WRITING TO TEACH SCIENCE: RESCUING THE LABORATORY REPORT

Judith A. Swan, Dept. of Chemistry, Princeton University, Princeton, NJ 08544

Measured in terms of pages per semester, students in a laboratory science course produce on average as much written prose as their peers in a humanities course, but the laboratory report is catagorized so separately from the essay and term paper that it seems something other than "writing." Yet approaching the lab report from the perspective of composition can illuminate both the writing and the science. In particular, student lab reports typically suffer from confusion about action and agency -- the "four hours in the laboratory and I still don't know what happened" syndrome. By considering their lab reports as writing subject to rhetorical principles, students can develop tools that push them into deeper analysis and understanding of the science. Moreover, this approach reinvigorates a traditional assignment, allowing faculty and students to reap some of the benefits of writing to learn science without having to create (and grade) additional assignments.

38B-4 CHEMISTRY AND SOCIETAL ISSUES: A WRITING COURSE FOR NON-SCIENCE MAJORS. J. N. Cooper, Chemistry Department, Bucknell University, Lewisburg, PA 17837-2005

A successful terminal chemistry course for non-science, liberal arts majors has been developed around the writings of such well-known authors as Mark Twain, Primo Levi, Berton Roueche, John McPhee and Oliver Sacks. Students write a series of four papers over the course of the term. The requirements for, and expectations of, the papers are staged incrementally within the context of formal instruction in, and discussion of, both chemistry and writing. Explicitly covered aspects of writing include mechanics, organization and style as well as content. Multiple revisions with peer reviews by other members of the class are implemented under the auspices of Bucknell's Writing-across-the-curriculum Program. Techniques, exercises and assignments will be discussed.

38B-5
WRITING IN A LARGE NON-SCIENCE INTRODUCTORY CHEMISTRY CLASS.
Herb Hedgecock, Dept. of Physical Sciences, Morehead State University, Morehead, KY 40351

MSU is making an effort to emphasize more writing and thinking skills in its introductory chemistry class (90 students) mostly of nursing, agriculture, and other allied science students. This group of students typically has a low interest in science classes plus limited communication skills. Some of the writing techniques and activities, how grading was handled, outcomes, frustrations and problems (both teacher and student), and suggestions for change and improvement will be discussed.

38B-6 WRITING IN CHEMISTRY COURSES FOR NURSING AND NON-SCIENCE MAJORS.
C. Valdez Gauthier. Department of Chemistry and Physics, Salem State College, Salem, Massachusetts 01970.

Nursing students and non-science majors often come to chemistry courses with the notion that succeeding in chemistry involves memorizing formulas and plugging numbers into equations. While there is some truth to this notion, I have tried to expose my students to "another side of chemistry" by introducing a writing component in my chemistry classes. The writing assignments are designed to promote critical thinking and to evaluate the students' problems and progress. In this talk, I will discuss the use of journals, précis and creative writing in general, organic and biochemistry courses.

The Non-Traditional Student *Monday Afternoon*

40-1 GENERAL CHEMISTRY AT XAVIER UNIVERSITY OF LOUISIANA. Ann Privett, Department of Chemistry, Xavier University, New Orleans, LA 70125

General Chemistry at Xavier University (a historically, black university) has been modified to simultaneously maintain high academic standards and provide extensive support for the underprepared student. The major components of the course are:

1. Standardized course content that is determined by the department as a whole rather than the text or the individual teachers.
2. Codification of content into a required workbook which is supplemental to the text.
3. Early intervention through academic advising by faculty in their major department.
4. Peer tutoring in the entry-level science and math courses.

40-2 FILLING THE PIPELINE: A CELEBRATION OF DIVERSITY. Nancy Cox-Konopelski, ACE Honors Program, University of California, Santa Cruz, CA 95064

In response to a national charge to produce well-prepared scientists from underrepresented groups, UCSC has developed the ACE, ACademic Excellence, Honors Program. This program is modeled after Uri Treisman's Professional Development Program (PDP) at UC, Berkeley and based on collaborative learning where students work in small groups for communal goals. These small discussion sections compliment the large lectures in entry level math and science courses. In chemistry, ACE provides support for general and organic chemistry. The students spend 4 hours/week in section rather than 70 minutes/week of a normal discussion section. This time is **not** spent in remediation, but rather in problem solving at and above the level of that assigned as homework. While the model does not work for all students, data from the ACE Honors Program have consistently indicated that program members not only pass at a higher rate than the nonmember cohort, but also perform at a higher level.

40-3 A PROFILE OF STUDENTS TAKING A DISTANCE LEARNING COURSE IN CHEMISTRY FOR NONSCIENCE MAJORS. Margot K. Schumm, 4908 Melinda Court, Rockville, MD 20853

Of all students taking chemistry at Montgomery College, a comprehensive Community College in Montgomery County Maryland, students taking this College of the Air chemistry course were the most interesting and diverse. A student profile will be shown. Also on display, will be a sample syllabus, sample exams, laboratory exercises and other more nontraditional assignments.

40-4 19 YEARS OF NON-TRADITIONAL STUDENTS IN THE ACCESS EVENING DEGREE CH151/209 CONSUMER SCIENCE AND CH140/211 SCIENCE OF ENOLOGY (WINEMAKING) COURSES AT THE MAIN AND SATELLITE CAMPUSES. Frank J. Gadek, Natural Science Department, Allentown College, 2755 Station Avenue, Center Valley, PA 18034-9568

19 years of experience with more than 600 non-traditional and traditional students in these two very popular and successful courses will be compared and contrasted. The vast amount of assessment data (diagnostic tests, student performance profiles, Hill Opinion Poll, course grades/assignments, etc.) is being statistically analyzed for correlations and trends to further improve these courses to better meet the needs and requirements of these two very diverse audiences.

40-5 ENCOURAGING SUCCESS IN GENERAL CHEMISTRY FOR THE WORKING STUDENT. G. K. Vick, L.ElNaggar, M. P. Lee, Bucks County Community College, Newtown, PA 18940

During the past twenty years our students have changed from primarily recent high school graduates attending college full-time with relatively few outside concerns to primarily students who need to fit learning into a lifestyle already crowded with jobs and family responsibilities. Recognizing that our students do not have unlimited time, we have attempted to make General Chemistry more manageable while still maintaining a set of standards that will adequately prepare them to advance to the next level. As a result of our efforts we have dramatically increased the percentage of students successfully completing General Chemistry.

Teaching My Favorite Topic, E. Pulliam, R. Perkins, F. Cardulla, Organizers — *Monday Afternoon*

41B-1 MY FAVORITE TOPIC: CRUISING ON CHEMICAL EQUATIONS. Sherry Berman-Robinson, Department of Science, Carl Sandburg High School, Orland Park, Illinois 60462

Equations are a common tool throughout chemistry. How can we make these equations easier to understand and fun to do? Methods will be shown applicable to all levels of high school and introductory college chemistry. Let's relieve any stress related to this area of study and make descriptive chemistry more enjoyable rather than memory work.

41B-2 CHEMISTRY AND CRIME: AN INTRODUCTION TO FORENSIC SCIENCE, Lawrence J. Kaplan, Department of Chemistry, Williams College, Williamstown, MA 02167

This introductory course uses the fascination with crime detection and the discovery pedagogical approach to stimulate the students' interest in science and technology. The students are introduced to popular criminal cases (such as the assassinations of John Kennedy and Bobby Kennedy; the analysis of the Shroud of Turin; the Jeffrey MacDonald case; the Wayne Williams/Atlanta murders; and the deaths of celebrities such as Marilyn Monroe, Janis Joplin and John Belushi) in the lectures and then to the scientific principles and techniques used in their resolution. In the case-oriented laboratory program, the students collect evidence during their investigation of real-life (staged) crimes and then analyze the physical evidence in the "crime lab." Cases involving hit-and-run with analysis of trace evidence such as glass, soil and fibers; drunk driving or drug use with analysis of alcohol or drugs by infrared spectroscopy, thin layer chromatography and gas chromatography-mass spectrometry; assault with analysis of blood and body fluids with DNA fingerprinting; and arson with analysis of accelerants with gas chromatography provide a focus for the course. The principles of basis, analytical, and organic chemistry as well as of biochemistry, toxicology, pharmacology, and serology are needed to understand the investigation of this wide range of cases. (Partial support: the Alfred P. Sloan Foundation, NSF-UCC grant USE-9150710 and NSF-ILL grant USE-9050606).

41B-3 THE MIRACULOUS CHEMISTRY OF OXYGEN. John M. DeKorte, Department of Chemistry, Northern Arizona University, Flagstaff, AZ 86011

Oxygen forms compounds with most elements and is necessary for the combustion of most substances. Its mere existence in the atmosphere, failure to participate in spontaneous combustion reactions with most combustible materials under normal conditions and ability to participate in flameless combustion reactions under other conditions can be explained by considering concepts from chemical bonding, thermodynamics and kinetics. This presentation will give plausible explanations for the observed reactivity of oxygen and explain why the representation of chemical bonding in oxygen that is shown in some high school chemistry texts is incompatible with these observations.

41B-4 QUANTUM MECHANICS - MY FAVORITE TOPIC. Paul C. Groves, South Pasadena High School, 1401 Fremont Ave., So. Pasadena, CA 91030.

An acceptance of quantum mechanical ideas provides beginning chemistry students with the basis needed to understand a variety of important chemical concepts including bonding, resonance, molecular orbital theory, conducting polymers, color, organic mechanisms, and molecular shapes. In addition, students often find it interesting to see a little of the wider world of chemistry ideas. Using many media I explore quantum mechanics with my students from waves and their oddities to the electron as a four-dimensional vibrating wavicle. Teaching ideas include the Aufbau Hotel, Flatman, and the EMR Ruler.

41B-5 SOLUTIONS--A FAVORITE UNIT OF MY STUDENTS. Maria R. Walsh, Pike High School, 6701 Zionsville Road, Indianapolis, IN 46268

In my classroom, students "do" chemistry. In many of my units, students learn material by performing mini-experiments and activities, using computer simulations, doing guided reading, and performing formal laboratory experiments. In this presentation, I will share one unit that is popular with my students: "Solutions".

41B-6 USING FAR SIDES IN THE CHEMISTRY CLASSROOM. Lawrence F. Brough, Department of Chemistry, Spring Hill College, Mobile, AL 36608.

Professional speakers have long understood the importance of humor in public speaking. As a forum for transmitting knowledge, chemistry classes of various types may also benefit from the planned injection of humor. Single panel comics such as "The Far Side" work especially well since they are concise, easy to integrate and have immediate impact. Humor in this form is useful for helping students focus their attention and clear their minds at the beginning of a lecture or discussion. Carefully chosen Far Sides can deepen thinking skills and provide innovative, irreverent and even insightful introductions to various chemical topics. Best of all, intelligent humor of this sort provides diversity, is relaxing and helps build class morale. Numerous examples, some just for fun, will be shown throughout this talk.

42B-1 A HISTORY OF THE VAN ARKEL BOND-TYPE TRIANGLE. W. B.Jensen, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221-0172

After first tracing the history of each of the three limiting-case bond models (ionic, covalent and metallic), this richly illustrated talk will look at the history of various graphical attempts, both qualitative and quantitative, to represent the gradual transition between these idealized limits, some of which go back to the 1930's. The talk will conclude with a summary of the author's own work in this area and his experiences in using the resulting quantitative van Arkel diagrams in both his introductory and advanced inorganic courses during the last decade.

42B-2 BOND TYPE DETERMINED BY TWO ELECTRONEGATIVITY FUNCTIONS. G. D. Sproul, University of South Carolina at Beaufort, Beaufort, SC 29902

An empirical relationship of two functions of electronegativity, χ, successfully predicts metallic, covalent and ionic bond character. Several χ scales were selected for evaluation, and a data set of binary compounds of known bond types was created. Graphs of differences in χ, $\Delta\chi$, versus average χ, $\bar{\chi}$ for these compounds gave 2-D triangular plots showing fractional bonding contributions arising from increasing covalency along $\bar{\chi}$ and from increasing ionicity along $\Delta\chi$, thus making intuitive chemical sense. All but one scale produce graphs that give segregation of better than 87% for all compounds with χ's defined by that scale; two scales, those of Allen and of Nagle, provide better than 96% separation. The fallacy in using the single function $\Delta\chi > 1.7$ (Pauling scale) as ionic is clarified using the two functions $\Delta\chi$ and $\bar{\chi}$ in a two-dimensional plot.

42B-3 CHEMICAL BONDING WITHOUT QUANTUM MYSTERY. John P. Ranck, Department of Chemistry, Elizabethtown College, Elizabethtown, PA 17022

The only force significantly operative in chemical bonding is the electrostatic force. Quantum concepts such as wave-particle duality, indeterminacy, and "exchange forces," which are normally introduced in an *ad hoc* fashion, are shown to derive from the very physical processes of observation, description, and measurement applied to small systems. With this understanding, classical electrostatics, properly considered, is sufficient to explain chemical bonding.

42B-4 A UNIFYING MODEL FOR ATOMIC, MOLECULAR ORBITAL, VALENCE BOND-HYBRIDIZATION AND VSEPR THEORIES. H. J. Teague, Department of Physical Science, Pembroke State University, Pembroke, NC 28372.

An alternative treatment to the current approach of many textbooks wherein molecular orbital theory, valence bond-VSEPR theory and hybridization theory are separate entities is presented. In the presented model valence bond-VSEPR and hybridization theories are shown to be interrelated. Molecular bonding and structure is presented as a sequential progression from the (spherical) atomic state through the sp linear, sp^2 trigonal, and sp^3 tetrahedral states. The progression from linear structure to trigonal structure to tetrahedral structure is proposed as resulting from the **"collapsing"** back lobe of a p orbital that becomes sigma bonded and subsequent re-distribution of the remaining electron dense regions to the minimum energy arrangement. A modified L.C.A.O.-M.O. model, although not constructive to the proposed approach, is discussed.

42B-5 A SIMPLE, RELIABLE MODEL FOR PREDICTING STRUCTURES AND PROPERTIES: COULOMBIC MODELS AS AN ALTERNATIVE TO ELECTRONEGATIVITY
L. J. Sacks, Christopher Newport University, Newport News, VA 23606

A Coulombic bonding model that has been used at levels from high school to advanced college courses will be described. It is shown to provide not just explanations after the fact but significant predictions of structure type and properties for a wide range of substances. Exceptions to Lewis structures and electronegativity rules, such as molecular BF_3, Fe_2Cl_6, $TiCl_4$ and even B_2H_6, but salts CaI_2, $TiCl_3$ and $FeCl_2$, are directly predicted. Polarity of molecules is shown to be essentially independent of "bond polarity", depending, instead, on total molecular geometry and, particularly, on lone pair orientation. Other properties better understood through Coulombic models include relative acidities; bond energies (bond energy of methane is calculated within experimental error); and rotation barrier in ethane (also calculated within experimental error). A few simple rules are given for structure prediction, from which predictions of properties follow.

Conversation: Is the ACS Approved Curriculum Outdated?
M. Kenney, Organizer

Monday Afternoon

46-1 THE ACS CURRICULUM FOR CHEMISTRY MAJORS: IS IT OUTDATED? G. A. Crosby. Department of Chemistry, Washington State University, Pullman, WA 99164-4630.

The current malaise about science education and the low state of science literacy in the Nation is indicative of systemic problems in the curriculum at all levels for the general student. Moreover, the restructuring of the economy that is underway also points to a reexamination of the science curriculum for those with a science orientation. The author will raise the question of the relevance of the current chemistry curricula in view of the literacy question, the trends in the economy, and the outlook for future employment opportunities.

46-2 ACS-CPT GUIDELINES AND CURRICULAR REFORM. J. R. Mohrig, Department of Chemistry, Carleton College, Northfield, MN 55057

The Winds of change are sweeping new ideas of pedagogy and content into the undergraduate chemistry curriculum. Do CPT standards, by their very nature, set up real barriers to this process? Or is it more likely that chemists' perceptions of such barriers are the real impediment to change?

46-3 RECENT EVOLUTION OF THE ACS APPROVED CURRICULUM FOR CHEMISTRY MAJORS. G. A. Hamilton, Department of Chemistry, Penn State University, University Park, PA 16802.

Some of the recent changes in the ACS approved curriculum for Chemistry majors and the philosophy behind these changes will be briefly reviewed and discussed.

46-4 THE ACS COMMITTEE ON PROFESSIONAL TRAINING: QUIS CUSTODIET IPSOS CUSTODIES? G. M. Bodner, Department of Chemistry, Purdue University, West Lafayette, IN 47907.

The Latin quote cited above translates as: "Who will care for the caretakers?" This paper will examine the extent to which the ACS-approved curriculum still meets the goals set forth when the CPT was established (see Haenisch and Wiig, Association of American Colleges Bulletin, 1956, 42, 321-336). It will then use research done by the author in the CPT archives [see Signs and Traces, Model Indicators of College Student Learning in the Disciplines, C. Adelman. Ed., Office of Research, U.S. Department of Education] to examine whether the similarity among chemistry curricula is the result of the CPT or whether the existence of the CPT reflects similarity in curricula.

46-5 OUTLINE FOR A NEW CURRICULUM. E. Wildi, Department of Chemistry, Nazareth College, 4245 East Avenue, Rochester, NY 14618-3790

An entirely new curriculum for chemistry majors is outlined. Traditional subject areas are largely abandoned in favor of organization by models and tools. For example, much Inorganic and Organic chemistry can be combined in an area emphasizing the molecular orbital model of reaction mechanisms. The kinetics should be included in the instrumental course introducing the tools for gathering kinetic data. Some traditional subject matters should be dropped for several reasons. First, the major is too long. Students no longer have enough electives available to develop the kind of thoughtfulness which is required to use chemical skills in the best interests of humanity. Furthermore, unless the incoming freshman starts immediately, it is no longer possible to finish the major in 4 years. Second, the major is unattractively difficult. Since 2/3 of chemistry majors do NOT go on to graduate school in chemistry, some of the most difficult subject areas might be eliminated to bring the difficulty level of the study back in line with other areas of college education. Finally, many vitally important and interesting areas of modern chemistry, such as polymers science and solid state theory, are neglected in the curriculum as it stands and need to be included.

57A-1 WHO'S LAB IS IT ANYWAY? Claire A. Baker, The Indiana Academy for Science, Mathematics, and Humanities, Ball State University, Muncie, Indiana 47306

During the lab phase of many high school and college courses, students perform experiments using procedures that are presented in recipe format, record data in blanks provided and complete a report by answering prescribed questions. It is the position of this presenter that this process does not produce meaningful learning. In this presentation strategies for providing increased student participation in experiment design and report preparation will be presented. Strategies for student ability ranging from at-risk to gifted students will be included.

57A-2 INSTRUMENTATION IN THE HIGH SCHOOL CHEMISTRY CLASSROOM--FTIR. Maria R. Walsh, Pike High School, 6701 Zionsville Road, Indianapolis, IN 46268

Until recently, chemistry students were able to experience sophisticated instrumentation only in college classes. With the increasing availability of instruments through educational-industrial alliances, through van projects, and through donations to schools, high school students are now being exposed to a variety of spectrophotometers, gas and high performance liquid chromatographs, and other instruments. In this presentation, I will describe a unit, appropriate to the high school student, developed for the FTIR. This unit will become a part of the library of experiments used in conjunction with the Purdue Instrumentation Van Project.

57A-3 STUDENT DESIGN OF PROJECTS FOR FRESHMAN CHEMISTRY. Zexia Barnes, Dan Adsmond, Department of Physical Sciences, Morehead State University, Morehead, KY 40351

Freshman laboratory experiments for which the procedures are spelled out and the outcomes are expected do not enhance student enjoyment of chemistry or their perception of how science is conducted. After having students perform experiments in which they have made an increasing number of decisions themselves, they are assigned two projects for the last 8 weeks of the semester. The students must use the literature and previous experience to decide on an approach to making the sampling and the analytical measurements required. The experiments used will be presented as well as results of a student attitude survey.

57A-4 STUDENT DESIGNED EXPERIMENTS IN FIRST YEAR COLLEGE CHEMISTRY. Timothy Hoyt, University of Puget Sound, 1500 N Warner, Tacoma, WA 98416.

New laboratory experiments have been developed, in response to our innovative freshman chemistry curriculum, that are intended to extend the open discussion format of the lectures into the labs. Extraction of Natural Indicators, Unknown Gases, Radon Detection, Building a Better Battery, and Analysis of Consumer Products are some of the experiments that have been developed. A major goal of the course has been to maintain a level of rigor to prepare some of the students for a science major while also allowing the non science students to participate fully in the class discussions and laboratory experimentation. In many of these open inquiry experiments the students design their own experiments to test hypotheses they develop in the laboratory. Using topical material from the course, the students get an opportunity to experience the thrill and excitement of laboratory successes as well as the other aspects of experimental work.

57A-5 THE TIMING OF ORGANIC LAB: THE ULTIMATE ORGANIC CHEMISTRY EXPERIMENT. A.E. Moody and K.A. Foster, Division of Science, Northeast Missouri State University, Kirksville, MO 63501.

Organic Chemistry laboratory is an integral component of the education of organic chemistry students. In spite of its universality, students and faculty often state that improvements could be made in the organic chemistry laboratory curriculum. This work details an investigation of how the administration of this lab affects student learning and morale. A two credit hour lab offered at NMSU has been shown to be a viable alternative to the traditional two semesters for one credit hour each. Also, survey results from a variety of institutional settings detailing their approaches to teaching organic chemistry labs has been collected. Included in this data are the timing of organic labs relative to organic lectures, the amount of time that students spend in lab, the focus(es) of the lab experiments, and the extent of incorporation of microscale experiments in the curriculum.

57A-6 GULLIVER'S TRAVELS IN ORGANIC CHEMISTRY: A COMPACT, COMPREHENSIVE ORGANIC CHEMISTRY LABORATORY EXPERIENCE. R. L. Wilde, Department of Natural Science and Mathematics, Transylvania University, Lexington, KY 40508

The second term of organic chemistry laboratory at our institution is a miniature experience in the world of organic chemistry as a science and a profession. The requirements include library work, qualitative organic analysis, synthesis and communication of results. Details of course organization, course requirements, student comments and sample papers will be presented.

Learning Chemistry by Doing Chemistry: Undergraduate Research *Monday Evening*
J. Panek, Organizer

3-1 CHARACTERIZATION OF A QUANTITATIVE COLORIMETRIC ASSAY FOR USE IN THE STUDY OF L-AZETIDINE-2-CARBOXYLIC ACID METABOLISM: AN UNDERGRADUATE RESEARCH PROJECT. Nichole M. Beck, Rakesh Bose, and C. Larry Bering, Department of Chemistry, Clarion University, Clarion, PA 16214.

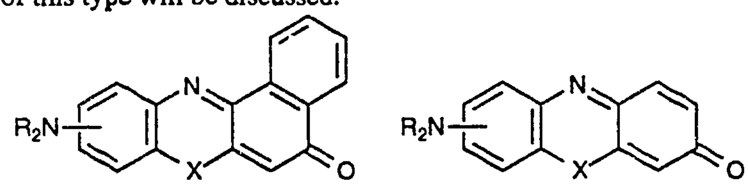
In an effort to develop an assay to measure the degradation and metabolism of L-azetidine-2-carboxylic acid (LACA) in bacteria, we noticed that a distinct colored product was formed with p-dimethylaminobenzaldehyde (Ehrlich's reagent; DMAB). Originally we suspected that the color was due to a proposed semialdehyde intermediate in LACA degradation, but it was discovered that the reagent forms the complex with LACA. The complex has an absorbance maximum at 403 nm, and obeys Beer's Law up to the millimolar range. We are using this reagent to monitor the enzymatic degradation of LACA. However, we were also interested in actual structure of the colored complex, as the higher homologs of LACA- proline and pipecolic acid- fail to react with DMAB. Attempts are underway to purify sufficient amounts of the product to determine its structure using IR and NMR spectroscopy.

3-2 **ELECTRODEPOSITION OF COPPER ON CONDUCTIVE POLYMER FILMS STUDIED BY THE EQCM TECHNIQUE** *Yi-Ming Chen and Maria Hepel*
Department of Chemistry, State University of New York at Potsdam, Potsdam, NY 13676

Electrodeposition of copper on conductive polymer films with different composition have been studied. The composition and conductivity of the substrate was changed by incorporating a variety of bulky anions into polypyrrole during its electropolymerization process.. Composite polypyrrole films were formed on 10 MHz AT-cut gold piezoelectrodes. The rate of copper electroplating on composite polypyrrole was followed *in situ* by recording frequency changes of piezoelectrodes using the Electrochemical Quartz Crystal Microbalance (EQCM) technique. The effect of electrodeposition potential on the nucleation density has been determined using Scanning Electron Microscope (SEM). The correlation was found between the observed nucleation density and current-time and frequency-time transients. Significant effect of the composition of the electrode substrate on the plating rate of copper was found. An enhancement of the copper electrodeposition was observed on composite polymer films with cation-exchange dynamics.

3-3 SYNTHESIS AND SPECTRAL CHARACTERIZATION OF POTENTIALLY SOLVATOCHROMIC FLUOROPHORES. Jennifer Rutherford, Gretchen M. Rehberg, and Brian W. Williams Department of Chemistry, Bucknell University, Lewisburg PA, 17837

With the goal of discovering useful or improved fluorescence probes, we have initiated the synthesis and spectral characterization of some potentially solvatochromic fluorophores (see figures). Synthetic approaches and preliminary spectral data for some compounds of this type will be discussed.



R = H, O, alkyl X = S, NH, NR', etc.

3-4 ENVIRONMENTAL PHOTOCHEMISTRY: THE PHOTOLYSIS OF AQUEOUS SOLUTIONS OF AROMATIC ORGANOMERCURY COMPOUNDS, Dylan Stewart, Thomas Dowd, Maureen DeTar, Scott Lew, Mathew Pietrzykowski and Nicholas Zevos, Chemistry Department, Potsdam College (SUNY), Potsdam, NY 13676.

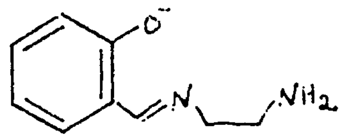
The compounds studied have the general formula XC_6H_4HgOH, where X is a COOH or SO_3H group. Irradiation of dilute aqueous solutions of p-hydroxymercuribenzioc acid with ultraviolet light of 253.7 nm results in a photoconversion to p-hydroxybenzoic acid and 3,5 dihydroxybenzoic acid. Quantum yields for product formation and reactant disappearance were measured both spectrophotometrically and by high performance liquid chromatography. The dependence of the quantum yields on reaction conditions such as photon flux, initial reactant concentration, solvent polarity and pH have been determined.

Initially the study focused on steady state experiments to provide information on the stoichiometry of the reaction, but current experiments have focused on two types of investigations:

(a) Experiments that sensitize the photochemical process.
(b) The use of laser experiments that will provide an insight into the nature of the intermediates that are involved in the reaction.

3-5 VANADIUM(V)-FACILITATED HYDROLYSIS OF BIS(SALICYLIDENE)ETHYLENEDIIMINE. R. L. Fisher and C. A. Root, Department of Chemistry, Bucknell University, Lewisburg, PA 17837.

It has been shown that a series of tridentate Schiff base ligands form stable complexes with cis-dioxovanadium(V). When the tetradentate ligand, Sal_2en^{2-}, is used, the ligand is not accommodated by the cis-dioxo metal ion. One of the two Schiff base linkages hydrolyzes to form a complex with the unusual ligand, enSal, containing a primary amine.



enSal

3-6 **GRAHAM'S LAW REVISITED - WHY A SIMPLE CLASSROOM DEMONSTRATION GIVES INCONSISTENT RESULTS.** J. R. Blackburn, M. H. Wilson, Department of Chemistry, Georgetown College, Georgetown, KY 40324

Graham's Law of Effusion (Diffusion) is commonly demonstrated in classrooms using cotton moistened with solutions of HCl and NH_3 at either end of a glass tube and allowing diffusion of the two gases towards each other to produce a visible ring of NH_4Cl. The distance each gas travels correlates with Graham's Law rates of diffusion. This experiment, while elegantly simple and theoretically logical produces inconsistent results in actual practice. Reasons for these inconsistencies have been explored and evidence will be presented to explain the anomalies.

3-7 RESEARCH AT THE UNDERGRADUATE-INDUSTRIAL INTERFACE. Paul E. Beck, Department of Chemistry, Clarion University of PA, Clarion, PA 16214.

This paper will summarize a five year on-going research program supported by Kalama Chemical, Inc., Kalama, Washington. We will focus on the early efforts in the synthesis of coumarin, our contribution to the commercial success of benzyl acetate, and the current efforts to develop an inexpensive synthesis of salicylaldehyde. The most current work from the summer of 1994 will be presented.

3-8 THE ROLE OF UNDERGRADUATE RESEARCH IN A NEW CHEMISTRY MAJOR AT A SMALL COLLEGE. Mary G. Chisholm and Alan J. Jircitano, The Pennsylvania State University, Behrend College, Erie, PA 16563.

The first students graduated from a new chemistry major at Behrend College in 1988. At its inception the decision was made to make research a requirement for graduation because the faculty believed in the value of research as a teaching tool. This paper will describe how this goal was developed and sustained in the first years of the program by examining the impact of student goals, funding, time (faculty and students), internal support, and the constraints of both short and long term planning. Research programs in synthetic and analytical organic chemistry, coordination chemistry and the computational chemistry of small molecules will be described, showing how they have begun to meet the needs both student and faculty.

3-9 TERNARY ZINTL PHASES AS PRECURSORS FOR III-V SEMICONDUCTOR MATERIALS. Teresa Birdwhistell[1], Tammy Jeffries[1], Cheryl Klein[1], Brent Koplitz[2], Paul Barnes[2], David Dennison[2], Keith Dillon[2], 1. Department of Chemistry, Xavier University, New Orleans, LA 70125; 2. Department of Chemistry, Tulane University, New Orleans, LA 70118.

Zintl phase materials arise when highly electropositive metals (i.e., Groups 1 and 2) are combined with less electropositive metals and metalloids (e.g., the post transition metals). These materials can be described as polar metallic alloys in which the bonds have a significant amount of ionic character. A large number of ternary Zintl phases have been characterized which are attractive single source precursors of important III-V semiconductor compounds. The laser ablation and redeposition of these materials as thin films is currently being explored in a collaborative effort between Xavier University and Tulane University involving undergraduates from both schools. The synthesis and characterization of two ternary Zintl phases, $K_3Ga_3As_4$ and $K_2Ga_2Sb_4$, will be presented along with the results of the deposition studies on these two compounds.

3-10 A NOVEL APPROACH TO OPTICALLY ACTIVE CYCLOALKENONES. Thomas T. Shawe, Andrew A. Ross, Patrice M. Robinson, Annatina Cannon, Anthony Prokopowicz, Department of Chemistry, Bucknell University, Lewisburg, PA 17837

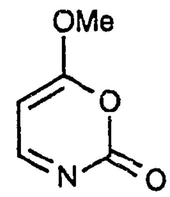
The synthesis of optically active, polysubstituted cycloalkenones has presented many challenges to the synthetic organic chemist. An approach that is based on the Stork-Danheiser ketone synthesis has been developed toward the synthesis of these valuable precursors. The key step in this approach is the stereoselective alkylation of an optically active cyclohexanedione derivative, with subsequent conversion to the enone using an unprecendented transformation.

3-11 ITERATIVE REDUCTIVE ALKYLATION APPROACH TO ALKALOIDS. Thomas T. Shawe, John P. Fulmer, Charles J. Sheils and Sean M. Gray, Department of Chemistry Bucknell University, Lewisburg, PA 17837

A new approach to the synthesis of alkaloid natural products has been developed. An aminoalkene is ozonized to provide a crude aminodiketone. Treatment with cyanoborohydride in the same pot results in iterative reductive alkylation reactions to provide a bicyclic tertiary amine. This feature is common to many alkaloid natural products. The application of this approach to the quinocarcin skeleton will be presented.

3-12 USE OF CYCLIC 1-AZADIENES IN DIELS-ALDER REACTIONS. Gretchen M. Rehberg and Brian M. Glass Department of Chemistry, Bucknell University, Lewisburg PA, 17837

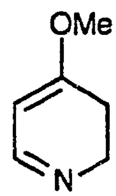
The use of 1-aza-1,3-butadienes in Diels-Alder reactions is well documented. Less well studied are the cyclic systems which will form bicyclic products when they undergo DA reactions. We will report our progress on the the synthesis of an interesting cyclic azadiene, 4-methoxy-1,3-oxazine-2-one **1**, and its cycloaddition reactions with dienophiles.



1

3-13 USE OF CYCLIC 1-AZADIENES IN DIELS-ALDER REACTIONS. Gretchen M. Rehberg and Jodene M. Nelson, Department of Chemistry, Bucknell University, Lewisburg PA, 17837

The use of 1-aza-1,3-butadienes in Diels-Alder reactions is well documented. Less well studied are the cyclic systems which will formbicyclic products when they undergo DA reactions. We will report our progress on the the synthesis of an interesting cyclic azadiene, 1-aza-4-methoxy-1,3-cyclohexadiene **1**, and its cycloaddition reactions with dienophiles.



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3-14 POLYMER ELECTROLYTE MATERIALS WITH MOLECULAR LEVEL PROTECTIVE COATINGS. Dale Teeters, Kent Cleavelin, and Chad Bauerly, Department of Chemistry, The University of Tulsa, Tulsa, OK 74104

Polyethers such as poly(ethylene oxide) which have been complexed with various inorganic salts of low lattice energy are known to have appreciable ionic conduction through the polymer matrix. Because of this property, these polymer-salt complexes are presently being used in new, solid electrolyte battery systems and for other electronic applications. However, one of the problems with polymer electrolyte batteries is the chemical reaction of the polymer with the electrode materials such as lithium metal. This reaction can result in a passivating layer being formed at the electrode/electrolyte interface reducing battery performance. The undergraduate research presented here involves the use of surface chemistry to place surfactant molecules at the surface of solid polymer systems. This molecular layer has the potential to protect the polymer electrolyte from chemical interactions with electrode materials and thus increase battery life. Conductivity measurements and surface analysis of the polymer with the surfactant coating will be discussed. In addition this work will be placed in context with past undergraduate research on ion conduction in polymers that has been conducted at The University of Tulsa.

15A-1 A HYPERCARD CHEMISTRY TUTOR BASED ON ARTIFICIAL INTELLIGENCE AND COGNITIVE SCIENCE. Michael A. Redmond, Computer Science, Rutgers University, Camden, New Jersey, 08102 and Susan R. Phillips, Natural Science and Mathematics, Holy Family College, Philadelphia, Pennsylvania, 19114.

Computer-based tutors can serve as an adjunct to classroom instruction, providing feedback, reinforcement, and practice. The most common form of computer-based tutor poses problems, asks the student for the answer, and tells whether the student is correct. In this research, a tutor has been created that goes beyond that, using strategies from artificial intelligence and cognitive psychology. In the current version, the task taught is balancing equations; future topics are planned. The tutor has been developed using Hypercard on the Apple Macintosh.

15A-2 CUPLE-ING CHEMISTRY AND PHYSICS. R. L. Hartshorn and P. H. Davis, Department of Chemistry, University of Tennessee at Martin, Martin, Tennessee 38238

CUPLE (the Comprehensive Unified Physics Learning Environment (J.M. Wilson and E.F. Redish, *Computers in Physics* 6, 202 1992) is a multimedia development environment operating within MS-Windows. It combines hypertext materials (using Asymmetrix Toolbook), video from videodisc, videotape, or other sources, and computer data acquisition (using either the ULI from Vernier, or the IBM-PSL interface). Originally developed by a consortium of individuals to provide a unified approach to the development and distribution of multimedia instructional materials within the physics community, CUPLE is readily adapted to any of the sciences. Application of CUPLE to microcomputer based laboratory (MBL) experiments in teaching general chemistry will be demonstrated. A variety of sensors suited to the study of chemistry are available including temperature and pressure probes, a pH probe, a radiation detector, and a colorimeter. The use of both commercially available videodiscs and randomly accessible videotape to present laboratory exxperiments for student analysis will also be demonstrated.

15A-3 **CURVYARO: AN INTERACTIVE COMPUTER INSTRUCTIONAL WORKBOOK FOR LEWIS VALENCE BOND STRUCTURES AND ELECTRON BOOKKEEPING.**
Thomas D. Walsh, Department of Chemistry, University of North Carolina at Charlotte, Charlotte, North Carolina 28223.

CURVYARO allows students to develop skills in problems involving electron bookkeeping. Such problems include drawing Lewis structures, using VSEPR, but mainly using curved arrows to follow electron relocation in chemical reactions (hence the name CURVYARO). The program eliminates problems we have encountered using a workbook which allowed students to look up the answer instead of working the problem.

Another advantage of the program is that the instructor can easily edit all instructional material presented to the student, according to instructor preferences. An authoring system approach allows changes to be made without any programming.

Comparative results indicate that the program is more effective than the workbook, at the 80% confidence level.

CURVYARO has been adapted for use in General Chemistry and both introductory and advanced levels of Organic Chemistry.

15A-4 REPORTING RESULTS WITH COMPUTERS: LABORATORY REPORT WRITING WITH WORD, EXCEL AND SUPERPAINT. John W. Henderson, Chemistry Department, Jackson Community College, Jackson, Michigan 49201

In preparation for the second semester of the first year chemistry course, Jackson Community College students now take the one-credit, seven-week course "Microcomputer Use in Science and Engineering" to introduce them to the use of the programs Word, Excel and SuperPaint in the context of writing laboratory reports. The Macintosh-based course emphasizes aspects of these programs, such as super- and subscripts, tables, graphing, etc., that are quite different from those covered in writing and business courses. The presentation outlines the topics covered in this course and displays copies of the handouts and weekly assignments.

15A-5 AUTOMATICALLY GRADED PERSONALIZED HOMEWORK FOR FRESHMAN CHEMISTRY James D. Spain, Dept. of Chemistry, Clemson University, Clemson, SC 29634-1905

One of the standard methods of teaching college chemistry is to have students perform assigned problems from the text. For several years, various authors have tried to improve on this system by use of computers. Some have employed computer centers, others have tried printouts of randomly generated problem sets. During the past year, we have been testing a system in which students are given a disk of computer programs designed to randomly generate personalized problem sets. This system, which presents problems individually on the computer screen, offers the following advantages over other modes of problem generation. 1) A program on a given topic randomly generates a personalized problem set for each student to prevent copying and generate more student interest. 2) Students get immediate feedback about the correctness of a problem and instruction on the correct solution when a problem is missed. 3) Students get an opportunity to repeat a missed problem using altered data. 4) The homework assignment is fully graded before it is submitted, either in printed or electronic form. The 24 IBM-based programs covering the major learning objectives of freshman chemistry have been used successfully by many thousand students at Clemson and elsewhere during the six year period of development. The new programs, when published, will have the advantage of making computerized homework available to instructors who do not have access to computers specifically for chemistry instruction.

15A-6 STOICHIOMETRY AND ECONOMY -- A COST MINIMIZATION ANALYSIS EXPERIMENT. Edward A. Mottel and Howard L. McLean, Rose-Hulman Institute of Technology, 5500 Wabash Avenue, Terre Haute, IN 47803

Rose-Hulman Institute of Technology has completed the fourth year of an integrated freshman year curriculum in science, engineering and mathematics. An effect of the curriculum is the development of new experiments and modification of older experiments using technology from other disciplines. The experiment Stoichiometry and Economy involves the thermal decomposition of sodium bicarbonate to sodium carbonate, the final step in the Solvay Process. Class data is pooled and the percent conversion is fitted as a function of heating time with the use of the data fitting application *DataExplorer*. Heating costs are also described as a function of heating time, and the combination of these two costs results in a function which can be minimized and displayed with computer algebra software, such as *Mathematica*. This brings an economic perspective to a stoichiometry experiment. The experiment introduces enough variables and assumptions into the mathematical fitting of the data and analysis of results that few students agree on an exact answer. Although analysis of each report requires time, it helps focus on the fundamentals of the experiment and the importance of making reasonable assumptions. The presentation will involve audience participation in a cooperative learning format. The experiment also helps students realize that there is not always a clear "correct" answer. Examples of student reports will be provided.

15A-7 MACINTOSH COMPUTERS IN ORGANIC CHEMISTRY LECTURE AND LAB. D. E. Marko, J. Z. Gillies, and E. W. Wolpaw, Chemistry Department, Siena College, Loudonville, NY 12211

See Wednesday Afternoon, 48B-2.

15A-8 A MATHEMATICA PROGRAM FOR SOLVING THE SCHROEDINGER EQUATION. John C. Hansen, Minnesota State University - Akita, Akita, JAPAN (on leave from Southwest State University, Marshall, MN, USA)

A Mathematica program which solves the one-dimensional Schroedinger equation for any user-specified potential is described. It is intended for use in a standard undergraduate Physical Chemistry course. Its purpose is to give students a tool which allows them to discover principles of quantum mechanics by computer experimentation and also to introduce Mathematica at a basic level. The potential may be chosen from one of a set of standard forms including harmonic oscillator, Morse, and Lennard-Jones. Alternatively, the user may enter their own potential by specifying its value at certain points and allowing the computer to interpolate. The wave equation is solved by diagonalizing a grid-based Hamiltonian. The numerical method used will be described and examples of its application will be shown.

Cultivating Problem Solving in the Undergraduate Organic Laboratory, E. Harrison, Organizer — *Monday Evening*

34-1 GRAY MATTER IN THE ORGANIC CHEMISTRY LAB. THE "MYSTERY REACTION" AS A VEHICLE FOR ENHANCING THINKING AND LEARNING. Nancy E. Carpenter and LoriAnn Lentsch, University of Minnesota, Morris, Morris, MN 56267

The organic chemistry laboratory course is often known as a "cookbook" lab, where the typical student follows a procedure (recipe) in the laboratory text without any expenditure of thought. In order to enhance the student's ability to analyze and solve problems, we have been engaged in an overhaul of the organic laboratory curriculum. In this presentation I will focus on the incorporation of the "mystery reaction," an approach that allows the student to discover the excitement of meaningful scientific inquiry and develop his or her own analytical skills in the solution of a problem. By presenting the experiment in such a way that the student is solving a mystery (e.g. attempting to discover the type of reaction, or determine what product is formed), the experiment more accurately mimics a real-life research experience. Other approaches to encourage the application and development of problem-solving skills will also be presented.

34-2 DEVELOPMENT OF A PROBLEM SOLVING LABORATORY FOR ORGANIC CHEMISTRY. J. H. Cooley, Department of Chemistry, University of Idaho, Moscow, ID 83844.

The most important educational reason for requiring laboratory is to help students understand the methods and the intellectual process by which the subject is studied. The process developed in the last two hundred years has been to make observations, collect data and to interpret these observations and data. The laboratory is used by scientists to try to answer questions. To simulate this use, students should be asked to seek answers to questions also. To accomplish this, techniques for obtaining data must be introduced and mastered by students well enough so that the data they get is of value for interpretation. Instruction in interpretation of data and the use of such interpretation for solving problems must be given. A description of how the change to a problem-solving laboratory has evolved in our program will be given.

34-3 USING THE PINACOL REARRANGEMENT TO TEACH TECHNIQUE, STRUCTURE DETERMINATION, AND MECHANISMS. B.J.Wojciechowski and S.T. Deal, Department of Chemistry, Georgia Southern University, Statesboro, GA 30460-8064.

The organic chemistry laboratory should be an exciting place where novice chemists can discover the wonder of chemistry. Many early organic laboratory exercises are done exclusively to teach a technique. While learning the technique is a valuable experience, the experiments are often dull and the students forget the technique. In an effort to improve this type experiment, we have combined a technique lab with a discovery lab. The basis of the experiment is the acid-catalyzed reaction of 2,3-dimethyl-2,3-butanediol - the Pinacol Rearrangement. Students are given the starting material, reagents, and procedures, but are not told the identity of the product. They obtain IR and NMR spectra of the product, determine its structure, and propose a mechanism for its formation. We find that this lab awakens student curiosity, helps them to learn and remember the technique, and improves their mechanistic reasoning.

34-4 PUZZLE SOLVING IN THE ORGANIC LAB USING NMR SPECTROSCOPY. Alex T. Rowland, Department of Chemistry, Gettysburg College, Gettysburg, PA 17325.

The aim of the introductory organic lab has begun to shift from a "let's make something" to "let's interpret the results". Recognizing that most organic students will never become research chemists, we have emphasized the importance of understanding concepts and the interpretation of experimental results by utilizing these concepts. We attempt to have students think in addition to "do". The analysis of ^{1}H and ^{13}C NMR spectra plays the key role in our approach. Some of the experiments to be discussed will include the determination of the electron density at side-chain atoms in substituted styrenes, the calculation of $\Delta G°$ in a substituted cyclohexane, the constitution of the air-oxidation product of an enone, and the determination of ring size in carbohydrate acetonides.

34-5 CULTIVATING PROBLEM-SOLVING AND COLLABORATIVE LEARNING IN THE UNDERGRADUATE ORGANIC LABORATORY: THE SYNTHETIC SEQUENCE APPROACH. E. A. Harrison, Jr., Department of Chemistry, Penn State York Campus, 1031 Edgecomb Avenue, York, PA 17403.

A synthetic sequence involving the preparation of six unknown compounds has been developed and forms the basis for an approach used in our undergraduate laboratory for a number of years. The class is divided into pairs, with each member of the pair assigned the responsibility for carrying out one-half of the sequence and isolating, purifying and obtaining spectroscopic data etc. on the three compounds so obtained. Each pair then works collaboratively to deduce the structures for all six compounds, propose reasonable mechanisms for certain of the reactions etc. and generate a written report summarizing its findings. The specific procedural details of this approach will be presented and its pedagogic features discussed.

34-6 A SCHIFF BASE PUZZLE FOR THE ORGANIC CHEMISTRY LABORATORY, David Todd, Department of Chemistry, Juniata College, Huntingdon, PA 16652

In this experiment, carried out on a one-millimole scale, the student is asked to choose one of five aromatic amine solutions and one of five aromatic aldehyde solutions. These are combined, allowed to react, and the Schiff base is isolated and its melting point determined:

$$\mathrm{ArC(H){=}O + Ar'\text{-}NH2 \longrightarrow ArC(H){=}NAr'}$$

A matrix giving the twenty-five possible Schiff base melting points, as a function of aldehyde and amine, is provided. To solve the identification problem, two Schiff bases must be prepared because of the considerable number of melting point coincidences. The choice of the second Schiff base to prepare requires a bit of logic on the part of the student.

34-7 AN ACETYLENE IDENTIFICATION PUZZLE EXPERIMENT FOR THE ORGANIC CHEMISTRY LABORATORY, David Todd, Department of Chemistry, Juniata College, Huntingdon, PA 16652

The student picks one of eight unknown acetylenes (they are all either terminal or symmetrical acetylenes) and carries out the acid-catalyed hydration of the acetylene. The resulting ketone is converted to two solid derivatives, out of a choice of six:

$$\mathrm{RC{\equiv}C\text{-}H \longrightarrow RC({=}O)\text{-}CH_3 \longrightarrow R\text{-}C(CH_3){=}N\text{-}N(H)\text{-}C({=}O)\text{-}\phi}$$

A matrix is provided that shows the melting points of all of the known derivatives corresponding to the 48 possible combinations. The student is asked to identify the unknown acetylene. The fact that some of the derivatives are not known confronts the student with a simple fact of life in chemistry!

44-1 THE KNIGHT'S MOVE IN THE PERIODIC TABLE. Michael Laing, Department of Chemistry, University of Natal, Durban 4001, South Africa.

There is a generally unnoticed regularity amongst the d^{10} metals on the lower right-hand side of the periodic table. For example thallium(I) and silver(I) form similar compounds; while both zinc and tin most effectively plate steel. Thus, the chemical properties of a metallic element of electron configuration $d^{10}s^2p^x$ (or $d^{10}p^x$) are similar to those of the metallic element having the configuration $d^{10}s^2p^{x+2}$ (or $d^{10}p^{x+2}$), one period below and two places to the right in the Periodic Table. The properties of a 3-d^{10} element of atomic number Z are similar to those of a 4-d^{10} metal of atomic number Z+20; a 4-d^{10} metal of atomic number Z is similar in properties to the 5-d^{10} element of atomic number Z+34.
This relationship is termed the Knight's Move.

44-2 A PERIODIC TABLE FROM A DIFFERENT SET OF RULES. Richard S. Treptow, Department of Chemistry and Physics, Chicago State University, Chicago, IL 60628.

Since the days of Mendeleev two conventions have guided the design of periodic tables. First, the periodicity of elements is based upon their macroscopic properties. These properties reflect how atoms behave when in contact with other atoms. The second convention is to reveal periodicity by placing elements with similar properties close to one another. Typically, all members of a family appear in a column.

Let us construct a periodic table following a different set of conventions. The new table will be based on spectroscopic properties of free gaseous atoms, rather than the properties of atoms in a chemical environment. It will illustrate periodicity by a technique other than grouping elements of a family together. When the new table is complete, we will ask what it teaches.

44-3 THE (NEARLY) IDEAL PERIODIC TABLE. George Gorin and Ann Ratcliffe, Chemistry Department, Oklahoma State University, Stillwater, OK 74078.

e	1	2	2	2	2/1	1/2	2	2/1	2/1	1±1	1	2	3	4	5	6	7	8/2
1	*H*																	He-
2	Li	Be											*B*	*C*	*N*	*O*	*F*	Ne
3	*Na*	*Mg*											*Al*	*Si*	*P*	*S*	*Cl*	*Ar*
4	*K*	*Ca*	Sc	*Ti*	*V*	*Cr*	*Mn*	*Fe*	*Co*	*Ni+*	*Cu*	*Zn*	Ga	Ge	As	Se	*Br*	Kr
5	Rb	Sr	Y	Zr	Nb-	Mo	<Tc>	Ru-	Rh-	Pd-	*Ag*	Cd	In	*Sn*	Sb	Te	*I*	Xe
6	Cs	*Ba*	*	Hf	Ta	W+	Re	Os	Ir	Pt	*Au*	*Hg*	Tl	*Pb*	Bi	Po	<At>	Rn
7	<Fr>	Ra	**	<104	....	....	....	....	>									
6a		*	La	*Ce*	Pr	Nd	<Pm>	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
7a		**	Ac	Th	Pa	*U*	<Np>	<Pu>	<95	....	....	....	....	....	....	....	103>	
I	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
M	1	2	3	4	5	6	7	8	8	8	1	2	3	4	5	6	7	

[Key: Row e: # of electrons in the highest ($s+p$) levels ("X±" has more/fewer electrons); Row M: Mendeleev group; Row I: group numbering system recommended by IUPAC; 32 "most important" elements are in *italics*; <X> is not found in Nature; Zig-zag line separates metals from nonmetals.]

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58A-1 A COOPERATIVE GROUP LABORATORY INVESTIGATION. H. P. Williams and H. F. Woodruff, Department of Chemistry and Biochemistry, University of Southern Mississippi, Hattiesburg, MS 39406-5043

Industrial members of our External Advisory Board pointed out that students are well pepared to work as individual chemists but that more effort should be directed toward cultivating cooperation between people. To this effort the first of several planned laboratory experiments has been designed and implemented. Students work in groups of four, with each individual member contributing uniquely in the laboratory aquiring the chemical and physical evidence which will be used to write an MSDS sheet on an unknown material. The team has one spokesperson and all must agree upon what is to be investigated and included in the final report. Each member is accountable to the team and part of the grade they receive is based upon how well the group cooperated in achieving their common goal. Both team and individual results assessments will be discussed.

58A-2 UPDATING THE CLASSICAL CHEMISTRY LABORATORY Rudolph W Kluiber Department of Chemistry, Rutgers University, Newark, N.J. 07102

The General Chemistry Laboratory is an excellent medium for learning but it is labor intensive. Unfortunately, as generally practiced, it can suffer from variability in quality of teaching and grading. To overcome these deficiencies, we have made the following modifications. A manual, specific to our laboratory, has been written. Videos have been created to replace the instructor's talk. Computer programs have been written in which the student first enters experimental data, then calculated values and finally receives a grade. These programs provide warnings and suggestions to remedy poor experimental work or calculations. Finally we use some of our best chemistry majors as "Tutors" to assist in the laboratory.

58A-3 CHEM MATTERS: LABS WITH STORIES. David Robson, Editor, *Chem Matters*; Mary Olenick, Managing Editor.

In addition to presenting articles about real world chemistry, *Chem Matters* has published dozens of lab activities--each related to an article in the magazine. The combination of an interesting article and an experiment that illustrates the chemical principles behind the article makes for high-interest labs and answers the classic student question "What is the stuff in the textbook good for?" Presenters will also discuss how to submit articles for publication in *Chem Matters*.

58A-4 FOURTH AND FIFTH GRADERS AS CHEMISTS. Jean C. Beckman and William A. Morrison, Department of Chemistry, University of Evansville, Evansville, IN 47722.

Fourth and fifth graders know a lot about the immediate world they live in, have reasonable manual dexterity, can read and follow directions, and are wildly curious and eager to try new things. This makes them wonderful students for hands-on, investigative chemistry. Over several years, with the cooperation and support of their teachers, we have developed a series of six one-hour chemistry classes for Horizons (gifted and talented) students at a local elementary school. These classes include some demonstrations but emphasize student investigation and discovery. Students work in groups of about five using "kits" assembled in small boxes. Each kit includes small dropper bottles of appropriate reagents and a multi-well spot plate. After they are given instructions, the students carry out a number of reactions, record their observations and draw conclusions.

58A-5 A LOW-COST, CENTIGRAM BALANCE THAT STUDENTS CAN BUILD

John H. Bedenbaugh, Don L. Tyrone, and Angela O. Bedenbaugh, Box 8466, University of Southern Mississippi, Hattiesburg, MS 39406-8466

Many high schools have poorly equipped chemistry laboratories with insufficient balances (sometimes none!) for individual student use. This often means that the student is denied the experience of doing quantitative experiments in the laboratory.

We have developed a build-it-yourself balance from inexpensive, readily available materials. Using our plans any student can construct his/her personal balance which will weigh up to 100 g masses with a sensitivity of 1 centigram. This rugged, direct-weighing balance can be built at a cost of $2.00-3.00. It permits the weighing of materials with an accuracy equal to that obtained with commercial mechanical ''centogram'' balances costing $150, or electronic balances costing $375 or more. A balance will be displayed and directions for building and using it will be available.

58A-6 INCREASING THE ACCURACY OF TITRATIONS PERFORMED WITH BERAL PIPETS

John H. Bedenbaugh, Angela O. Bedenbaugh, and Ava P. Gunn, Box 8466, University of Southern Mississippi, Hattiesburg, MS 39406-8466

In our experience when Beral pipets are used for titrations, both the precision and accuracy of the results are very poor. Our conclusion is that most people cannot control drop delivery from a Beral pipet very well. The fingers become fatigued and often drops are ejected too quickly. If the fingers relax, air bubbles form in the stem of the pipet. Moreover, it is difficult to hold the pipet at the same angle all the time.

We have overcome all these problems by developing an easily assembled, low-cost apparatus that holds a microtip Beral pipet at a 90° angle to the desktop and permits mechanical compression of the body of the pipet via a modified screw clamp slipped over the body of the pipet. Benefits are: uniform drop size, elimination of finger fatigue, elimination of air bubbles, and the ability to interrupt a titration and then resume from the same point (almost impossible with finger-compression of a Beral pipet).

Users of this apparatus have achieved considerably greater precision and accuracy in titrations.

The titration apparatus will be displayed.

58A-7 MICROSCOPES IN GENERAL CHEMISTRY LABORATORIES. Robert B. Gayhart, Department of Chemistry, Bradley University, Peoria, IL 61625

A 10-40 power zoom stereomicroscope conveniently provides enhanced observation of the formation and growth of metal dendrites, ionic crystals, and other evidence of micro-scale reaction. Products of reactions which might be evident to the naked eye as a rather ordinary discoloration or formation of nondescript precipitates can be beautiful when viewed with the microscope. Studies of the electromotive series (e.g., deposition of silver on copper, lead or zinc) and use in qualitative analysis (e.g., discrimination of lead(II) chloride, silver chloride and mercury(I) chloride) can be demonstrated.

58A-8 IMPROVEMENTS IN THE QUANTITATIVE ASSAY OF NONREFRACTORY MINERALS FOR FE(II) AND TOTAL FE USING 1,10-PHENANTHROLINE.

J. Charles Templeton and James R. Nelson, Department of Chemistry, Whitman College, Walla Walla, WA 99362, and James E. Amonette, Earth and Environmental Sciences Center, Pacific Northwest Laboratory, Richland, WA 99352

An improved method for the determination of Fe(II) and total Fe in nonrefractory minerals using 1,10-phenanthroline has been developed. The previous practice of performing much of the analysis under a red photographic lamp or in complete darkness has been replaced by a method that can be performed in a lighted laboratory using opaque bottles. Other improvements to the method include the substitution of gravimetric for volumetric measurements of analytical reagents and the use of a more intense light source to increase the rate of photochemical reduction during the total Fe assay. Details of the analytical method will be described and the effects of other metals on the analysis will be discussed.

58A-9 SIMPLE DEMONSTRATION OF LIGHTNING-INDUCED SYNTHESIS OF NO_x IN THE ATMOSPHERE. R. Navarro-González and S. Castillo-Rojas. Instituto de Ciencias Nucleares. Universidad Nacional Autónoma de México. A. Postal 70-543, México D.F. 04510, México.

Nitric oxide and ozone are produced naturally in thunderstorms by lightning discharges. This phenomenon can be simulated in the laboratory using a simple setup by exposing a sample of air to an electric discharge generated with a Tesla coil. It is necessary to spark the sample for about half-an-hour in order to increase the concentration of products for detection purposes. This over exposure leads to the oxidation of nitric oxide to nitrogen dioxide. The formation of nitrogen compounds can be demonstrated with a specific reaction for nitrites. There are mechanistic differences between the natural and experimental phenomena. This experiment can be used to introduce concepts such as plasma chemistry, free-radical chemistry and atmospheric chemistry.

58A-10 AN EYE-OPENING EXPERIENCE: THE CATALYTIC DECOMPOSITION OF HYDROGEN PEROXIDE, Brendan R. Flynn, Department of Chemistry and Chemical Engineering Technology, Broome Community College, Binghamton, NY 13902

A commercially available patented system designed to clean and disinfect soft contact lenses consists of dilute hydrogen peroxide solutions and a platinum coated plastic disc which catalyzes the decomposition:

$$2H_2O_{2(l)} \xrightarrow{Pt} 2H_2O_{(l)} + O_{2(g)}$$

This inexpensive, safe, and portable system can be used in the classroom to demonstrate heterogeneous catalysis and to serve as a focal point from which to review some basic concepts of thermodynamics and kinetics.

Other concepts which may be discussed are the need for isotonic saline solutions, the polymeric materials used to prepare the substrate, and the preparation of the platinum surface. All are discussed in the patent, which serves as a valuable technical resource.

58A-11 A SERIES OF RANDOM REACTIONS Alfred J. Lata, Department of Chemistry, 2010 Malott Hall, University of Kansas, Lawrence Kansas 66045

The mixing of various solutions, and the observation of reactions and resulting products are what many beginning students expect of Introductory Chemistry. From this 'simple' effort, much can be learned even by the beginner: careful and complete observations, homogenization of solution mixtures, and the fact that all combinations do not lead to reaction or a change as a result of mixing.

This presentation will show a method for making a large number of varied possible combinations of two and three components in a controlled fashion. A series of combinations of two and three randomly selected solutions from a small prime number of solutions can give many different possibilities for student investigation. Depending on the level of chemical sophistication of the student, various conclusions regarding the reactions can be made, but the observational aspects should be stressed.

58A-12 THE COMMON ION EFFECT: A SMALL SCALE APPROACH Mark Azar and Joseph T. Keiser, Department of Chemistry, The Pennsylvania State University, 152 Davey Laboratory, University Park, PA 16802

Our General Chemistry Laboratory Program has traditionally included a common ion experiment. In particular, the effect of K^+ on the $KHT(s) \leftrightarrow K^+(aq) + HT^-(aq)$ reaction. Recently, we have used "microscale" techniques to scale down this experiment by roughly a factor of 100. Not surprisingly, this significantly reduces the cost and the waste, and decreases the time required to conduct the experiment. Surprisingly, it does not significantly affect the results! A detailed comparison of the two approaches will be given.

58A-13 DATA PROCESSING IN PHYSICAL CHEMISTRY LABORATORIES. J. N. Cooper, Chemistry Department, Bucknell University, Lewisburg, PA 17837-2005

Physical chemistry laboratories at Bucknell have been developed to emphasize the importance and significance of processing data collected. A specially designed room immediately adjacent to the undergraduate physical chemistry lab enables students to use stand alone PC's as well as network to the University's mainframe computer. Formal instruction is included in linear and non-linear least-squares curve-fitting techniques, residual analysis, the F-test and the Durbin-Watson statistic to assess systematic deviations of collected data from proposed models and functional fits. Experiments are chosen to illustrate the principles of data analysis and assessment; they are deliberately kept technically modest, to focus students' attention on the interpretation of the data and the interconnection between experimental technique and the quality and significance of their results. These experiments include heat of solution as a function of salt concentration, heat of vaporization as a function of temperature, density of binary solution as a function of composition and viscosity of binary solutions as a function of composition. Specific examples of each will be discussed.

58A-14 **A COMPUTATIONAL ELABORATION ON A CLASSIC PHYSICAL CHEMISTRY LABORATORY EXPERIMENT: THE SEMI-EMPIRICAL DETERMINATION OF ΔpK_a AND SUBSTITUENT EFFECTS.** Robert Bell, Miranda Maxwell, and James Lo Bue, Department of Chemistry, Georgia Southern University, Landrum Box 8064, Statesboro, Georgia 30460

A system that should be well suited for semi-empirical analysis is the determination of the ΔpK_a of substituted naphthols. The relative rather than absolute nature of the calculation should allow for the cancellation of errors due to the approximations made by nonab-initio methods. From the standpoint of chemical education the problem could find a home as a capstone in which the connection between quantum mechanics and thermodynamics can be strongly bound. In the work presented, HyperChem is used as the calculational engine allowing the comparison of a number of algorithms illustrating numerous quantum computational principles. Further, the subject lends itself to a connection with principles from the organic chemistry curriculum by extension to the study of substituent effects and perhaps, dare we suggest, the demystification of "electron pushing."

58A-15 **ANALYSIS OF THE ETHYL ACETATE HYDROLYSIS SYSTEM: A GLIMPSE AT LEAST SQUARES IN A NON-LINEAR CONTEXT.** James M. Lo Bue and Robert N. Nelson, Department of Chemistry, Georgia Southern University, Landrum Box 8064, Statesboro, Georgia 30460

Several experimental difficulties make problematical the traditional analysis of the ethyl acetate hydrolysis system. This analysis requires experimental determination of an initial point and an infinity point based on a careful preparation of a blank and on the feasibility of waiting 24 hours to take final measurements. Linearization of the integrated kinetic equation and linear least squares fitting of the data yields the desired rate constant but only if the infinity point is well-characterized. An alternative method which is greatly facilitated by a new feature in the newly released Quattro-Pro for Windows 5.0 spreadsheet program is presented in which the three quantities: the rate constant, the infinity conductivity, and the initial conductivity can be determined by a self-consistent analysis of the data. Further, this system provides the opportunity to explore a remarkably rich panoply of statistical concepts.

58A-16 MICRO CHEMISTRY IN BRAZIL. Roque Cruz, ASSETA, Tatui College - S.P. - Brazil

Working with students in high school level, we have developed a complete school portable laboratory for group of 4 to 6 students with low cost equipment based in micro scale technology.

This laboratory provides more than 100 experiments, most suitable for the middle and high school level at Brazilian Schools. Students can handle their own experiment with safety, fastness and economy for the school budget.

We have used it during the whole school year and watched a high increase of interest from students in the subject. The laboratory has also been managed with theoretical classes, providing students with a different way (easier and faster) to understand lots of chemical concepts.

58A-17 Laboratory Competitions and Student Involvement. William E. Adams, Dept. of Chemistry & Physics, Salem State College, Salem, MA 01970.

Laboratory competitions that are fun to do can involve students so that they try hard to do well. Even when their grade is dependent on how well they do relative to other students, they enjoy the lab.

This presentation will describe the experience of the presenter in elementary schools, high schools and college.

58A-18 MACINTOSH COMPUTERS IN PHYSICAL CHEMISTRY LABORATORY. Jennifer Z. Gillies and Elizabeth Winter Wolpaw, Department of Chemistry, Siena College, Loudonville, NY 12211

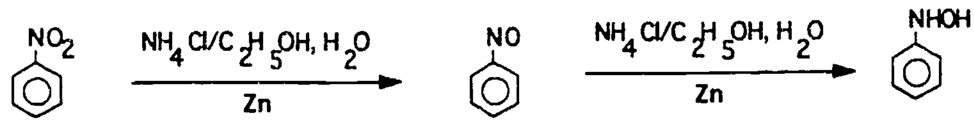
Macintosh computers have been integrated into the physical chemistry laboratory curriculum to enhance data collection and analysis. Spreadsheets and graphing software allow students to evaluate the quality of their results during a lab session, when there is still time to re-run an experiment or modify a procedure. We have also found that we can do more sophisticated experiments at lower cost than previously. Students have been particularly excited about using the computers for data acquisition: Universal Laboratory Interface (ULI) boxes provide the equivalent of several solution calorimeters and pH meters. The interfaces can also be used with Spectronic 20's for kinetic studies. Other applications include use of software for calculations, orbital visualization, and molecular mechanics. The student response has been overwhelmingly positive and the quality of laboratory reports has improved markedly. Our program is further enhanced by the coordinated use of the Macintosh platform and common software throughout biology, physics, and math courses. The hardware and software were purchased with funds from Siena College and the NSF-ILI program (grant #USE-9250232).

58A-19 FROM TITRATION DATA TO BUFFER CAPACITIES: A COMPUTER EXPERIMENT.
Gary D. White, Roy W. Clark, Judith M. Bonicamp and Exum D. Watts. Department of Chemistry and Physics, Middle Tennessee State University, Murfreesboro, Tennessee 37132.

This poster paper is for all chemistry teachers who have beginning students, computers and spreadsheets and would like that combination to be more effective. We describe a computer experiment in which students will discover many things about pH, the taking of derivatives, buffer capacity and the way buffers behave upon dilution. We use a computer software package, EQUIL to generate data for the following titrations: 1. the reaction of 0.100 M HOAC(aq) with 0.100 M NaOH(aq) or 0.100 M HCl(aq) 2. the reaction of 0.100 M HCl(aq) with 0.100 M NaOH(aq) 3. the dilution of 0.100 M HOAc(aq) / 0.100 M NaOAc(aq) with H_2O 4. the dilution of 0.100 M HCl(aq) with H_2O. We provide instructions for students to transform and plot data from pH vs. mL to buffer capacity versus pH. We give suggestions for instructor's comments too. The dilution experiments develop the definition of a buffer capacity with respect to dilution which we call β_{dil} .

58A-20 THE SILVER MIRROR TEST USING PHENYLHYDROXYLAMINE. Wang Jianping, Luoyang Teacher's College, 471022, China

The literature indicates



but the resulting Ph-NHOH solution does not give a silver mirror upon reaction with Tollen's reagent. How can we prove that the above reduction has occured? We replace the NH_4Cl with NH_4NO_3, thus eliminating $Ag^+ + Cl^- \rightarrow AgCl_{(s)}$. Then,

$$\text{Ph-NHOH} + 2\,Ag(NH_3)_2 \longrightarrow \text{Ph-NO}_2 + 2\,Ag_{(s)} + 2\ NH_{3\,(g)} + 2\,HNO_3$$

Preparation of reagent: Mix 0.5 g Ph-NO_2, 10 mL 50% ethanol/water, 0.5 g NH_4NO_3 and 0.5 g Zinc powder in a large test tube. Shake to mix evenly, and insert a cork with 60-80 cm glass tubing. Put the large test tube in a boiling water bath for 10-20 min, cool to room temperature, and filter. Test: Put 1 mL Tollen's reagent and 1 mL of the above filtrate into a test tube. Shake, and put into a 60-80 ^{o} C water bath. A very bright silver mirror is produced.

58A-21 CHLORIDE SALTS AS CATALYSTS FOR THE SYNTHESIS OF PHENOLIC RESINS. Wu Yong and Wang Jianping, Naiping Teacher's College, 353000, China and Luoyang Teacher's College, 471022, China

Chloride salts may be better catalysts for the synthesis of phenolic resins than traditional acids or bases. The color, physical state, and uses of phenolic resins prepared with various salts differ significantly. They show less corrosion, have a lower cost, and are prepared more conveniently than those using HCl, NaOH or ammonia.

Chlorides tested were: $ZnCl_2$, $MgCl_2$, $CoCl_2$, $CaCl_2$, NH_4Cl, $AlCl_3$, $FeCl_3$. 8 H_2O. The best catalysts were: $FeCl_3$. 8 H_2O, $AlCl_3$ and NH_4Cl.

58A-22 GROUP ELECTRONEGATIVITY CALCULATIONS. Wang Jianping, Luoyang Teacher's College, 471022, China

Group Electronegativities are important parameters which can be used to explain some Organic Chemistry rules. There are three methods for calculating the group electronegativity. Using $-CH_2COOH$ as an example:

I) $\chi_{CH2COOH} = (\chi_C \cdot \chi^2_H \cdot \chi_{COOH})^{1/4}$ $\chi_{COOH} = (\chi_C \cdot \chi_O \cdot \chi_{OH})^{1/3}$ $\chi_{OH} = (\chi_O \cdot \chi_H)^{1/2}$

II) $\chi_{CH2COOH} = [\chi_C(\chi_C \cdot \chi^2_H \cdot \chi_{COOH})^{1/4}]^{1/2}$ $\chi_{COOH} = [\chi_C(\chi_C \cdot \chi_O \cdot \chi_{OH})^{1/3}]^{1/2}$
$\chi_{OH} = [\chi_C(\chi_O \cdot \chi_H)^{1/2}]^{1/2}$

III) $\chi_{CH2COOH} = [\chi_C(\chi_C \cdot \chi^2_H \cdot \chi_{COOH})^{1/4}]^{1/2}$ $\chi_{COOH} = [\chi_C(\chi_C \cdot \chi_O \cdot \chi_{OC} \cdot \chi_{OH})^{1/4}]$
$\chi_{OH} = [\chi_C(\chi_O \cdot \chi_H)^{1/2}]^{1/2}$ $\chi_{OC} = [\chi_O(\chi_O \cdot \chi_C)^{1/2}]^{1/2}$

We prefer method III, as it includes the atomic electronegativity of double bonded atoms. Selected group activities using the three methods are:

group	χI	χII	χIII	group	χI	χII	χIII
-COOH	2.89	2.77	2.782	-ONO2	3.37	3.37	3.426
-CHO	2.68	2.62	2.633	-OCOCH3	3.05	3.22	3.27

Posters: Teaching Organic Chemistry, P. L. Samuel, Organizer *Monday Evening*

58B-1 USING FT-IR TO FOLLOW MICROSCALE ORGANIC REACTIONS IN COMMUNITY COLLEGE. J. Ems-Wilson, Science and Technology Department, Valencia Community College, Orlando, FL 32802

This paper describes the introduction of FT-IR techniques and "windows" based software to our beginning organic students. It also describes several classic microscale experiments which use the FT-IR to follow the reaction. Reactions under investigation are: (1) conversion of cyclohexanol to cyclohexanone; (2) radical chlorination of 1-chlorobutane with sulfuryl chloride in combination with preparatory gas chromatography; (3) photoisomerization of azobenzene. The FT-IR and computer hardware were acquired from an NSF ILI grant (1994). Participation by the author in the NSF Microscale Organic Institute is also gratefully acknowledged.

58B-2 USING THE "DEMONSTRATIONS IN ORGANIC CHEMISTRY" VIDEODISC IN THE CLASSROOM. Gary L. Trammell, Chemistry Program, Sangamon State University, Springfield, IL 62794-9243

See Wednesday Afternoon, 48B-1.

58B-3 UNDERSTANDING SUBSTITUENT EFFECTS WITHOUT RESONANCE. Francis M. Klein, Department of Chemistry, Creighton University, Omaha, NE 68178

The influence of the nature as well as the location of a substituent on the energy of a delocalized system can be predicted, explained, and understood by students without the use of the resonance method with its arcane and sometimes confusing and misleading rules. In the author's approach to the problem, consideration of the orbitals involved and application of a few general principles describing the patterns of electron distribution within conjugated systems and the interaction of delocalized systems leads to the same semi-quantitative conclusions and predictions about the systems as are available through resonance considerations. Since it involves direct consideration of the orbital structure of the system, the approach gives a more "correct" description of the delocalized system than the resonance method offers, and does so with much less effort and much less confusion. This presentation will outline this orbital-based method, and demonstrate its application to several typical substituent-effect problems from the beginning orgnaic chemistry course.

58B-4 USE OF THE CHEMICAL LITERATURE AS AN ORGANIC LABORATORY EXERCISE. Andrienne C. Friedli and Martin V. Stewart, Department of Chemistry and Physics, Middle Tennessee State University, Murfreesboro, TN 37132

A laboratory "experiment" introducing sophomore organic students to the chemical reference section of the library is described. The self-paced assignment is counted as a normal lab write-up, and involves two parts. The first requirement is to collect labels from household products containing at least one organic compound. Using the Merck Index, the student can name the compound, draw its structure, and give a reason for its inclusion in the product. Five labels must be collected. In a second part of the assignment, the student must look up a specified compound in Organic Syntheses and answer questions about the procedure used to synthesize it. Inorganic reagents involved in the synthesis are researched in Reagents for Organic Synthesis. An introduction to collections of IR and NMR spectra can be added if the lab is used in the second semester sequence. The laboratory assignment can be conveniently scheduled during the week of Thanksgiving or another time when two equivalent lab sections get out of phase. A complete description of the assignment, student evaluations, and examples of the results will be exhibited.

58B-5 WRITE AN AUTOBIOGRAPHY OF A FUNCTIONAL GROUP...(CREATIVE WRITING IN CHEMISTRY). Jeff Hoyle, Chemistry Dept., Nova Scotia Agricultural College, Truro, Nova Scotia, CANADA B2N 5E3

This poster will discuss the use of creative writing in an introductory organic chemistry course taught to B.Sc. (Agr.) students. This has been an integral part of my introductory organic chemistry course for the last five years. All students are required to write a paper on one of several predesignated topics (worth 10% of the final course mark). This poster covers the topic - autobiography of a functional group. Many students choose this option and write very creative 'first-person accounts' of the chemistry of a functional group. Examples of some of the excellent work done by students of all levels of ability will be presented. In addition, a discussion of the students choices of a functional group and some advantages and pitfalls with this course component will be given.

58B-6 SMALL SCALE ORGANIC LABORATORY METHODS USING SUPPORTED REAGENTS AND SOLID PHASE EXTRACTION. David A. Nelson, Department of Chemistry, University of Wyoming, Laramie, WY, 82071.

Many synthetic methods normally presented in the undergraduate organic laboratory can be adapted to the use of supported reagents. Small scale reactions can be conveniently carried out using devices designed for solid phase extraction (SPE). SPE methods can be used directly for separation and isolation of reaction products. Reagents can be adsorbed on a variety of materials or bound ionically or covalently using styrene-divinylbenzene and silica supports. Experiments will be described that include acid-base-neutral separation, oxidation, reduction, esterification, aldol condensation, benzoin condensation, dehydrohalogenation, and alkylation. Use of these methods can substantially reduce or eliminate much traditional laboratory equipment. Reagent use, laboratory hazards, and disposal of hazardous waste can be minimized. An alternative approach to laboratory instruction based on these methods will be discussed.

58B-7 THE ISOLATION OF BETULIN FROM BIRCH BARK AND ITS REARRANGEMENT: A SOPHOMORE ORGANIC CHEMISTRY EXPERIMENT. Michael D. Bentley, Bongyoul Chung, and Brian Green. Department of Chemistry, University of Maine, Orono, Maine, 04469.

This experimental sequence for the beginning organic chemistry laboratory was designed for the middle to end part of the second semester when most of the laboratory skills have been acquired. It starts with a microscale natural products extraction in which betulin is obtained in high yield and purity by solvent extraction from an abundant and recognizable natural source, the bark of the paper birch. The subsequent acid-catalyzed rearrangement in the E-ring occurs in high yield and is accompanied by alcohol esterification in the A-ring, allowing illustration of the principles of carbocation rearrangement and ester formation. Finally a simple saponification provides a good example of a nucleophilic acyl substitution. A strong point of this sequence is that no time-consuming purifications are required, allowing it to be completed in two periods. Furthermore the progress can be followed entirely by 300 MHz NMR by reference to key signals. Analysis of the spectra provides excellent examples of the concepts of stereotopic nuclei, Karplus relationships, long-range coupling etc.

58B-8 KINETICS EXPERIMENT FOR UNDERGRADUATE ORGANIC CHEMISTRY LABORATORY
Stephen A. Steiner, Department of Chemistry, Bluffton College, Bluffton, OH 45817

A novel approach to the study of reaction kinetics in an undergraduate organic chemistry laboratory is described. Reaction rate data are collected by measuring the time required to consume a known amount of reactant, rather than by the more traditional approach of measuring reactant concentrations at various time points. The reaction being studied is the S_N1 substitution reaction of an alkyl halide with hydroxide to produce the corresponding alcohol. The reaction vessel is placed in a water bath and the reaction solution is mixed by magnetic stirring. Solvent is placed in the flask and a known amount of hydroxide is added along with a few drops of phenolphthalein indicator, giving the solution a pink color. The reaction is initiated with the addition of alkyl halide. A timer is begun with the addition of the alkyl halide and is allowed to run continuously throughout the reaction. As the substitution reaction takes place, the hydroxide is consumed and the solution becomes colorless. The time to consume the hydroxide is recorded and an additional portion of hydroxide is added to the reaction, restoring the pink color. The process is repeated until at least 10 time points have been recorded. The effect of temperature, solvent polarity, substrate structure, and leaving group can be examined by adjusting the reaction conditions and reagents. The data-collection phase of the lab typically takes 10 to 20 minutes, so several reactions can be carried out by a student in a single lab period.

58B-9 PHEROMONE SYNTHESIS AND BIOASSAY: APPLIED ORGANIC CHEMISTRY AT THE UNDERGRADUATE LEVEL Cheryl L. Wistrom, Department of Chemistry, St. Joseph's College, Rensselaer, IN 47978

Most traditional laboratory exercises involving organic syntheses end with the proper disposal of the product; no attempt is made to use the chemicals made and purified so carefully for anything other than qualitative analysis to prove identity. Carrying out such experiments can leave students feeling unsatisfied and missing the "big picture" that explains why such reactions are carried out. The exciting area of pheromone research presents an opportunity for showing students biological applications for organic syntheses. Presented here is a synthesis, purification, and bioassay for bornyl acetate, a synthetic cockroach sex attractant pheromone. This compound is made from camphor in two steps: reduction of the ketone to an alcohol followed by esterification with an acetyl group. The bioassay is carried out by exposing male cockroaches to the product and observing them for behaviors normally carried out in response to the presence of a female. Two enantiomers are produced in the reaction; an additional step can be taken to resolve them and carry out a bioassay on each.

58B-10 STUDENT HANDOUTS FOR THE MECHANISTIC ORGANIZATION OF REACTIONS OF CARBONYL COMPOUNDS WITH NUCLEOPHILES. John W. Henderson, Chemistry Department, Jackson Community College, Jackson, Michigan 49201

A large variety of reactions begin with the acid or base catalyzed attack of a nucleophile on a carbonyl carbon. In spite of the diverse products of such reactions, all of them belong to the same mechanistic matrix that begins with the formation of a tetrahedral intermediate which has different fates depending on the nature of the nucleophile and the groups originally bonded to the carbonyl carbon. To demonstrate this to my students and to help them to predict the product and mechanism of a given reaction from the structural features of the reactants, I have prepared a set of handouts that organizes these reactions into four classes (expanded from those in Kemp and Vellaccio's 1980 text) and have created a flow chart to show how to decide to which of the classes a given reaction belongs. To help students organize the synthetic interconversions among the common families of acyl derivatives, I also have a handout organizing these interconversions in terms of the relative stabilities of the families.

58B-11 TEACHING ORGANIC CHEMISTRY WITH TEAM LEARNING AND CASE STUDIES. Joseph F. Bieron; Frank J. Dinan, Department of Chemistry, Canisius College, Buffalo, New York 14208

A team learning method, extensively modified for use in teaching organic chemistry has been introduced and tested in the introductory organic chemistry course at Canisius College. Details of the team learning procedure, and the results obtained form cognitive and affective evaluations of the method will be described. The case study method is being used in conjunction with team learning in this experimental organic chemistry course. The use of case studies allows the introduction of a number of important social issues into the course which would otherwise be difficult to fit into an introductory level science course. It allows the "critical thinking" dimension of the course to be greatly expanded. Our experience with the case study method will also be described.

P-3 THE ROLE OF CATALYSIS IN ACHIEVING ENVIRONMENTALLY SUSTAINABLE GROWTH IN THE 21ST CENTURY, James A. Cusumano, Catalytica, Inc., 430 Ferguson Drive, Mountain View, California 94043

As we approach the next century, scientist and engineers will have unprecedented opportunity to address some of the most significant challenges ever to face humanity. For the most part, they fall in the areas of health care, food supply, energy, and materials. The common thread that penetrates each of these opportunities is the environmental factor. How do we develop new products without damaging the environment? The approach should be a shift to catalytic technology that dramatically reduces the environmental impact per unit of increased social prosperity. The essence of this strategy is Economic Primary Pollution Prevention. This means directing the tools of catalytic science and technology to develop and manufacture products that are economically superior to their counterparts, using processes that eliminate, or significantly minimize, the formation of environmentally unacceptable by-products. Pollution prevention will become increasingly more economic as society exacts higher prices on the use of the environment. A number of new clean technologies based on this strategy are on the horizon.

How Will National Initiatives in Science Education Affect the Teaching of High School & College Chemistry? B. Koloseike, Organizer *Tuesday Morning*

8-1 AAAS PROJECT 2061: A CHEMIST'S PERSPECTIVE. Jerry A. Bell, Education and Human Resources Directorate, American Association for the Advancement of Science, Washington, D.C. 20005.

"Science literacy" has emerged as a major educational reform goal for the United States. AAAS's Project 2061 is a long-term effort whose purpose is to contribute to attaining that goal for all citizens. This project is in three phases. Phase I focused on defining the knowledge, skills, and attitudes that would characterize a scientifically literate citizen. These are presented in Science for All Americans (SFAA), the major product of this phase. Phase II, now in progress, involves teams of teachers/scientists creating several alternative curriculum models based on SFAA. One result of this work has been Benchmarks for Science Literacy, the knowledge, skill, and attitude expectations at grade levels 2, 5, 8, and 12, that will meet the overall outcomes expressed in SFAA. Together with the Benchmarks, the outcomes of Phase II will be a set of Blueprints for reform related to the preparation of teachers, testing, equity, parents and the community, and other system issues and the creation of a computerized resource database to serve teachers, administrators, parents, community leaders, and others interested in educational reform. Phase III, a decade or more, will be a collaborative effort in which many groups will use the resources that have been created to move the nation toward science literacy. Where do chemists, chemistry, chemical educators, and chemical education at all levels fit into this design? Is it true, as some have charged, that "Chemistry is missing from SFAA"? More to the point: "What chemistry should a scientifically literate citizen know?" "Is this chemistry included in SFAA?"

8-2 UNIVERSITY CHEMISTRY, NATIONAL SCIENCE EDUCATION STANDARDS AND STATE CURRICULAR DEVELOPMENT. J. E. Bauman, Jr., Department of Chemistry, University of Missouri, Columbia, MO 65211.

The State of Missouri is undertaking a K-12 curricular reform involving performance standards for all public school students. The relationship of these standards to those being developed by the National Science Education Project and a new chemistry program at the University is shown. The common themes of universality, laboratory experience, subject matter, connections and the historical, societal and cultural aspects of chemistry will be shown. An examination of the high school-college interface will be presented for the new programs.

8-3 SCOPE, SEQUENCE, AND COORDINATION OF SECONDARY SCHOOL SCIENCE, Dorothy L. Gabel, Indiana University, Bloomington, IN 47405.

The National Science Teachers Association has developed a content core for secondary schools which serves as a guide for the design and construction of science curricula to restructure science education according to the complexity of the concepts to be taught. This presentation will describe the principles of scope, sequence and coordination, and how they relate to the restructuring process. Also included will be a discussion of NSTA's recommendations for the chemistry content that should be included in science courses at the various levels (6-8; 9-10; and, 11-12) of the secondary curriculum.

8-4 PROJECT KALEIDOSCOPE - WHAT WORKS IN SCIENCE EDUCATION, J. R. Mohrig, Department of Chemistry, Carleton College, Northfield, MN 55057

Building on the experience of many liberal arts colleges, Project Kaleidoscope has been working for over four years to identify and disseminate effective strategies for the reform of undergraduate science education. It has put into place a network for communication and partnerships between colleges, universities and the K-12 sector.

8-5 THE COUNCIL ON UNDERGRADUATE RESEARCH. Hans Veening, Department of Chemistry, Bucknell University, Lewisburg, PA 17837

The Council on Undergraduate Research (CUR) is a professional organization which aims to provide students at predominantly undergraduate colleges and universities with opportunities to learn science and mathematics by engaging in research with faculty members. Developing funding programs at the private and federal foundations to fund research at primarily undergraduate institutions, disseminating information about successful undergraduate research efforts and helping faculty members at these institutions to develop successful undergraduate research programs are the key elements of CUR's mission. The organizational structure of CUR and several of its initiatives such as Directories, the National Information Center for Undergraduate Research, the CUR Quarterly, National CUR Conferences, Consulting Services, Summer Student Grants and the "CURLS" Electronic Bulletin Board, will be discussed.

18-1 THE REMARKABLE MEMORY OF NICKEL-TITANIUM ALLOYS. Laura A. Wright, Department of Chemistry, University of Wisconsin-Madison, Madison, WI 53706

Nickel-titanium is a shape-memory alloy that exhibits a variety of unusual properties based on a solid-state phase transformation. Demonstrations will be presented that show how this high-tech solid, which is finding use in a broad range of commercial applications, can be used to illustrate many fundamental chemical principles, including phase changes due to applied pressure.

18-2 FERROFLUIDS AND MAGNETIC SMART MATERIALS. Donald R. Neu, Department of Chemistry, Saint Cloud State University, Saint Cloud, MN 56301

Ferrofluids were originally discovered in the 1960's at the NASA Research Center, where scientists were investigating different possible methods for controlling fluids in space. Recently, numerous applications for ferrofluids and other magnetic "smart" materials have been developed. Ferrofluid synthesis and applications will be presented and their properties demonstrated.

18-3 PIEZOELECTRIC MATERIALS. Gary E. Wnek, Department of Chemistry, Rensselaer Polytechnic Institute, Troy, NY 12180-3590.

There are many examples of ceramics and polymers which exhibit the phenomenon of piezoelectricity, where application of a mechanical stress leads to an electrical response and vice versa. Such materials have important uses as transducers which convert electrical to mechanical signals (e.g., in loudspeakers). We will explore the molecular origins of piezoelectricity, and will discuss the related phenomena of pyroelectricity and ferroelectricity. Applications will also be discussed. A simple demonstration of the piezoelectric effect will be given using a thin polymer film.

18-4 THE CHEMISTRY OF HIGH TEMPERATURE SUPERCONDUCTORS.
Margret J. Geselbracht, Department of Chemistry, Reed College, Portland, OR 97202

Since the discovery of high T_c superconductors in 1986, chemists have played an important role in the synthesis and characterization of these materials. A discussion of the latest superconducting oxides will emphasize fundamental concepts in chemistry, including structure and stoichiometry. An overview of the synthesis of superconductors will be presented, from what students can accomplish in an introductory chemistry laboratory to the latest advances in the synthesis of superconducting devices.

18-5 THE CHEMISTRY OF LED's AND LASER POINTERS. George C. Lisensky, Department of Chemistry, Beloit College, Beloit, WI 53511

Light-emitting diodes and diode lasers are constructed from combinations of semiconductors. The structure and composition of these solids provide excellent examples of fundamental chemical principles, including structure, bonding, spectroscopy, periodic and isoelectronic relationships, and stoichiometries based on substitutional solid solutions. Eye-catching demonstrations involving these high-tech devices, suitable for introductory chemistry courses, will be presented.

18-6 THE CHEMISTRY OF SOLAR CELLS AND PORTABLE REFRIGERATORS. Arthur B. Ellis, Department of Chemistry, University of Wisconsin-Madison, Madison, WI 53706

Semiconductors and water are characterized by similar equilibria. A variety of analogies between these two media will be drawn, including the resemblance of a p-n junction to an aqueous concentration cell. This junction serves as the basis for constructing solar cells, which can be used to "count photons" in introductory chemistry courses. The thermal and electrical relationships underlying portable refrigerators will also be demonstrated and discussed from a chemistry teacher's perspective.

Molecular Visualization: From the PC/Mac to the Workstation Environment, G. Bodner, Organizer — *Tuesday Morning*

21A-1 COMPUTER USE AND MISUSE IN THE CLASSROOM, Joseph Casanova and Sally Casanova, Department of Chemistry and Biochemistry, California State University, Los Angeles, Los Angeles, CA 90032 and California State University, Dominguez Hills, Carson, CA 90747

The use of the computer in the classroom gives us much greater efficiency in the presentation of information, but there is no assurance that students are able to absorb the additional information. The computer allows for the simultaneous presentation of graphic, pictorial, written, and oral information, but we don't know if simultaneous presentation enhances learning or makes assimilation, integration, and recall more difficult.

Students at the introductory level need to be carefully guided to link chemical imagery with chemical theory — but growing sophistication in the presentation of imagery has not been accompanied by a similar improvement in the teaching of theory. Any successful computer based approach involves rethinking the teaching of theory and increasing dependence on student-centered activities that integrate theory and practice. Some tests of the classroom application of these ideas will be discussed.

21A-2

DEMONSTRATIONS, MOLECULAR MODELING, AND COMMON SENSE. Brian P. Coppola, Department of Chemistry, The University of Michigan, Ann Arbor, Michigan, 48109.

Last September, we decided to push our successful *Structure and Reactivity* classrooms into the late 20th Century by using static and dynamic Chem3D™ projections in 2 of 3 sections of a 1200 student lecture course. Discussions of topics such as stereochemistry, reaction mechanisms, and molecular dynamics were supplemented with these visualizations. Specific assignments were not made, although site licenses allowed all students to have access to Chem3D™ and ChemDraw™ in our Science Learning Center and at public computer sites. Our observations about this experience reinforced what we continue to see as a two weaknesses in the momentum behind some very well-intentioned reform efforts: (1) students are not inherently motivated by the same things as their instructors, and (2) simply disguising difficult ideas in an attractive or interesting package is only the first step, not the last step, for using instructional strategies like demonstrations, molecular modeling, and other multimedia packages.

21A-3

PCMODEL: MOLECULAR MODELING SOFTWARE FOR PERSONAL WORKSTATIONS,

Joseph J. Gajewski and Kevin E. Gilbert, Indiana University, Bloomington, IN 47402

This paper will describe PCModel Version 4, which is a molecular modeling package for use with a personal computer. PCModel performs MMX force-field minimization calculations with 60 atoms types and generalized parameters, including functions and parameters for transition metals. It also does unrestricted Hartree-Fock Pi calculations for conjugated systems. PCModel can be used with transition-metal complexes that contain explicit sigma bonding, lone-pair coordination, and pi-system coordination for systems with an unlimited number of metals and up to 20 different metal types per structure.

21A-4 COMPUTATIONAL CHEMISTRY IN THE UNDERGRADUATE CURRICULUM.

W. S. Mungall and W. F. Polik, Department of Chemistry Hope College, Holland, MI 49423

Computational chemistry is having an enormous impact on the manner in which chemistry is practiced. Although powerful computational methods have been available to research chemists for many years, only recently has it been possible to incorporate computational chemistry into the undergraduate curriculum. With assistance from the NSF-ILI program and CAChe Scientific, Hope College has established a Computational Chemistry Laboratory for use by undergraduate students. The Laboratory is equipped with fifteen Macintosh computers networked with a multi-processor workstation to handle the major computational jobs. Thus, a whole laboratory section or small class of students can gain hands-on experience with computational chemistry. Students are first exposed to computational chemistry in the general chemistry classes where calculated molecular and atomic structures are displayed as examples using a projection system. In the organic chemistry laboratory, students use molecular mechanics calculations to compare the stability of isomers synthesized in the laboratory and to study the conformational energies of compounds. In physical chemistry, students calculate the infrared spectra of simple molecules and compare these results with high resolution spectra recorded in the laboratory. Students use more advanced computational methods in senior-level courses to gain insight on a variety of chemical problems. Students have also found computational methods to be very useful in their research projects.

21A-5 **COMBINING MOLECULAR MODELING AND SPREADSHEET ANALYSIS- AN ADVANCED EXERCISE IN PHYSICAL ORGANIC CHEMISTRY** R. Hallford, G. Wright and T. W. Hanks, Department of Chemistry, Furman University, Greenville, SC, 29613.

The study of synthetic host-guest systems has yielded a wealth of information about non-covalent binding forces. The practical application of this knowledge promises to greatly advance the technology of molecular design. Here we present a computer-based exercise in which students attempt to design a computer model of the complex interactions governing an actual host-guest system. Using experimentally determined binding constants and calculated molecular features, they develop, and then test theories of binding. Results from models developed by two of us will be presented as well as an overall evaluation of the exercise from a pedagogical standpoint.

From the Chemistry of Responsible Environmentalism to Environmentally Responsible Chemistry, J. Cooper, Organizer — *Tuesday Morning*

23A-1 INTRODUCING GREEN CHEMISTRY IN TEACHING AND RESEARCH.
Terrence J. Collins, Scott W. Gordon-Wylie, Robert E. Patterson, and Gregory P. Wakeham, Carnegie Mellon University, Department of Chemistry, 4400 Fifth Avenue, Pittsburgh, PA 15213

"Green Chemistry" is an area arising directly from scientific discoveries about pollution and indirectly from public perception just as the identification of a serious disease stimulates the call for a cure. Mankind now appreciates the importance of understanding the environmental consequences of each chemical technology and of ensuring that the benefits can be enjoyed without environmental penalties. A course on Green Chemistry will be described which has been introduced to encourage undergraduate seniors and graduate students to be aware that they can help in defining the emerging field centered on creating environmentally sound chemical processes. Information will be given on course objectives, course materials and how they were obtained, and requirements on the students for graded performance. The presentation also will deal with an emerging research program aimed at producing green metallo-oxidants. Designed ligand systems stable in oxidizing media can be adapted to extend the concept of recyclability to oxidation reagents. Research results aimed at producing site-isolated robust reagents for use in molecular sensing and in waste-free oxidation processes will be presented.

23A-2 ENVIRONMENTAL CHEMISTRY IN THE CHEMISTRY CURRICULUM. Judith A. Swan and Thomas G. Spiro, Department of Chemistry, Princeton University, Princeton, NJ 08544

In the standard curriculum, environmental chemistry is a diversion: an advanced elective, a human interest story at the edge of the main chemical story, often literally a box in the margin of the textbook. This treatment leaves an understanding of environmental issues until late in a student's chemical education. Moreover, it selects **for** students who can learn science as a series of abstract principles and **against** students who learn better when abstractions are embedded in a concrete context. In developing a chemistry course for non-science majors at Princeton University, we have inverted the usual perspective. In this course, "From Ozone to Oil Spills," environmental issues form the main "text" while the background chemistry becomes the box in the margin. This inversion produces some interesting results: It puts environmental considerations on a more equal footing with basic chemistry; it includes more students by making the material less abstract; and, it breaks down some of the boundaries between chemistry subfields by exposing students within a single course to topics from several disparate courses. Surprisingly, this course has been received most enthusiastically by students enrolled in the traditional chemistry sequence. These students find that considering environmental issues early in their education allows connections across the chemistry curriculum. Rather than a digression, environmental issues can create a path through much of chemistry that resonates with a broad range of students.

27A-1 A TEACHING ASSISTANT TRAINING COURSE. Tim Hoyt and William Dasher, Department of Chemistry, University of Puget Sound, Tacoma, WA 98416.

At University of Puget Sound the professors and undergraduate teaching assistants share duties in the running of our laboratory classes. We have developed a 3 hour course which is required for all new TAs and covers safety, emergency procedures and TA responsibilities. A detailed outline of this course will be presented and discussed. The course syllabus was developed using MSWord's™ outline feature which allows a detailed set of lecture notes to be displayed and printed when the full outline is selected. The outline can then be collapsed to different levels to help in organizing the lecture material, such as producing student lecture notes at level 2 to hand out or overhead transparencies. This also makes it particularly easy to modify the course material from year to year.

27A-2 TA TRAINING IN THE GENERAL CHEMISTRY LABORATORY PROGRAM AT PENN STATE UNIVERSITY. Kent Ballard and Joseph T. Keiser, Department of Chemistry, The Pennsylvania State University, 152 Davey Laboratory, University Park, PA 16802

We have taken an aggressive approach to TA training. On a typical semester, the start up of our General Chemistry labs is delayed for two weeks. During this time, the new TAs complete an accelerated version of the entire course under the direction of a top TA from the previous year. This includes writing up all of the lab reports for a grade. Also covered are the necessary administrative matters. This is followed up with biweekly meetings throughout the semester. This program has resulted in significant improvements in TA performance as well as morale. Details will be discussed.

27A-3 TEACHING ASSISTANT TRAINING IN WRITING. Stanley T. Marcus and Keith Hjortshoj, Baker Laboratory of Chemistry, Cornell University, Ithaca, NY 14853-1301

The Department of Chemistry at Cornell University has offered a comprehensive pre-service teaching assistant program for its incoming graduate students for more than a decade. Recently the summer program, which is offered before the graduate students begin their study at Cornell, has been expanded from four weeks to five weeks, in order to be able to include instruction in scientific writing and the evaluation of writing. It has been our experience that a substantial fraction of our incoming graduate students are not adequately prepared to evaluate the scientific writing produced by the students in our undergraduate courses. Having this program helps us to address this problem. A brief overview of the entire training program will be given, followed by a closer examination of the writing component.

27A-4 THE CHALLENGE OF TA TRAINING ON A SHOESTRING: TWO CONCORDIA PROJECTS.
M. E. Baldwin, Department of Chemistry and Biochemistry, Concordia University, Montreal, Quebec H3G 1M8, Canada.

Two on-going projects undertaken at Concordia, an urban university with a very diverse student body and severe budget restraints, will be discussed. The first is an initiative begun within the Department of Chemistry and Biochemistry in 1991 to address issues of safety communication, equity and diversity in the laboratory. "Inequity in the Classroom" is a multimedia package developed at Concordia by the Office of the Status of Women to address sexual and racial discrimination by instructors. The responses to the use of this programme with the Department's TAs and undergraduate demonstrators will be discussed. The second project is a broader initiative begun in 1993 to develop training for TAs within the Faculty of Arts and Science; efforts to integrate the Department's programme with that of the Faculty in order to maximise resources will be discussed.

Innovative Uses of Modern Instrumentation in Introductory Chemistry Courses, J. Steehler, Organizer — *Tuesday Morning*

31A-1 AN IR AND MW SPECTROSCOPY EXPERIMENT FOR THE BEGINNING LABORATORY.
E. Koubek and W. Heuer, Department of Chemistry, U.S. Naval Academy, Annapolis, MD 21401.

Most beginning chemistry courses introduce the concept of visible absorption spectroscopy, usually in the form of a laboratory experiment. However, little is said or done with regard to the IR and MW region. This is unfortunate as IR spectroscopy is potentially as useful a tool as any other form of spectroscopy. Also, students may be led to believe that only visible light interacts with matter. We have developed an experiment to illustrate how light in the IR and MW regions interact with matter and why and how this can lead to molecular "fingerprinting" and the so-called "greenhouse effect". The experiment requires little in the way of equipment and could be used in an Introduction to Science course as well as a beginning college or high school chemistry course.

31A-2 THE USE OF FTIR SPECTROSCOPY FOR THE CURRICULAR INTEGRATION OF GENERAL AND ORGANIC CHEMISTRY.
T.I. Spector, Department of Chemistry, University of San Francisco, San Francisco, CA 94117

The lack of an overt conceptual connection between general and organic chemistry courses presents a key stumbling block to student learning. This paper outlines an innovative curricular approach using Fourier Transform Infrared (FTIR) spectroscopy to actively reinforce concepts met in both general and organic chemistry. This approach is based on three factors: 1)Reinforcement of the concepts learned in general chemistry by applying techniques and examples from organic chemistry 2) Introduction of the methodology of infrared spectroscopy to students early in general chemistry, rather than later in organic chemistry and 3) Promotion of sequential, progressive, integrative learning of chemical principles. To reach these educational goals the introduction of a lab into the first-year chemistry curriculum involving the functional group analysis of prepared polymer films FTIR will be discussed. In the organic chemistry laboratory, the concepts learned in general chemistry can be reinforced via a systematic approach to FTIR spectroscopy. Experiments which illustrate this approach include: functional group analysis, examination of chemical equilibria, and examination of molecular environment.

31A-3 ORGANIC CHEMISTRY AND SPECTROSCOPY IN GENERAL CHEMISTRY. David M. Whisnant, Department of Chemistry, Wofford College, Spartanburg, SC

As part of an effort to bring modern instrumentation into our General Chemistry program, we have introduced a three-week organic chemistry/spectroscopy project in the second semester laboratory of the course. This project uses the molecular modeling program, HyperChem by Autodesk to help students learn about molecular geometry, organic chemistry, and spectroscopy. In the experimental part of the project, the students use FTIR and UV-visible spectroscopy, and prepare a compound using microscale organic synthesis. The project will be discussed along with a new ToolBook program which serves as a front-end for HyperChem.

31A-4 USE OF ADVANCED NMR TECHNIQUES IN GENERAL AND ORGANIC CHEMISTRY, Vernon R. Miller and Jennifer Muzyka, Department of Chemistry, Roanoke College, Salem, VA 24153.

The use of ^{1}H NMR in organic chemistry has become standard, and many schools are now also using ^{13}C NMR. The more "sophisticated" techniques, such as DEPT, COSY, NOESY, etc., however, are used very little. While it is true that these techniques require better instruments, and that some of these techniques are harder to interpret, it is also true that some of these "sophisticated" techniques are much easier to interpret than the standard ^{1}H NMR spectra. In our general classes we have used ^{13}C and ^{1}H, while in our organic class we have used automated collection of ^{1}H, ^{13}C, DEPT, HETCOR, and COSY. We will be discussing samples used, acquisition concerns, student learning, and student response.

31A-5 A COMPUTER-BASED INSTRUMENTATION SYSTEM FOR LOWER DIVISION LABORATORIES. John R. Amend, Department of Chemistry and Biochemistry, Montana State University, Bozeman, MT 59717.

Research-grade data resolution and flexible student programmability characterize Montana State University's approach to lower division laboratory instrumentation. This presentation will illustrate how multiple simultaneous measurements can open a chemical system to student view, and how research grade resolution can produce "textbook" data from simple experiments. Examples illustrated will include an inexpensive direct-reading 10 nM bandpass colorimeter, a safe method of acquiring live radioactive decay data for a dozen laboratory groups, and examples of high resolution thermometric data. This work is a product of the CCLI Initiative -- Computers in Chemistry Laboratory Instruction, a NSF-funded consortium of nine colleges and universities. CCLI members include Brigham Young Hawaii, Hope College, The University of Illinois, Mt. San Antonio College, Montana State University, Southwest Texas Junior College, The United States Air Force Academy, The University of British Columbia, and Western Washington University.

31A-6 INSTRUCTIONAL TECHNOLOGY IN A FRESHMAN HONORS LABORATORY COURSE. Estel D. Sprague, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221-0172.

Our freshman honors lab course has been restructured to incorporate the extensive use of commercially available computer-controlled lab interface devices, interactive lessons on laserdisc, and additional software. By learning to configure the interface devices as pH meters, colorimeters, etc., the students are enabled to delve more deeply into selected areas, including acid-base chemistry, electrochemistry, and chemical kinetics. The students have been required to participate fully in designing and interpreting the experiments they carry out in the selected areas, and this has provided a much more stimulating and meaningful learning experience than is possible in our more traditional laboratory.

Van Programs: Instrumentation on the Road to High Schools, D. Mitchell, Organizer — *Tuesday Afternoon*

6-1

A COMPREHENSIVE SCIENCE OUTREACH PROGRAM. Donald J. Mitchell, Department of Chemistry, Juniata College, Huntingdon, Pennsylvania 16652

With the help of grants from the National Science Foundation and other foundations, we have instituted a program that is intended to be a total support system for the high school teacher. It has grown from a small group of chemistry teachers in central Pennsylvania who wanted to form a support group among themselves to a $600,000/year program. The program now includes high school biology and chemistry teachers from more than 45 high schools in central Pennsylvania and the Mon Valley region of Pittsburgh. Using specially designed vans, certified science teachers deliver modern scientific instrumentation to high schools and support the local high school teachers in introducing students to the use of this equipment. There are summer programs where the teachers have the opportunity to practice using the equipment themselves and to work with other teachers to develop experiments for their classrooms. Seminars and Science Fairs are also conducted for the teachers and their students. In addition to the activities of the project, the principles upon which the outreach program is based will be discussed.

6-2 TEAM SCIENCE: AN OUTREACH. A.J. Banks, T.R. Boyette, D.G. Haase, J.C. Park, and R. Kirkley, The Science House, North Carolina State University, Raleigh, NC 27695.

The Team Science program has as its goal the improvement of the level of high school chemistry and physics programs in rural North Carolina schools. The counties of eastern North Carolina have large percentages of rural, poor, and minority students, and include some of the lowest achieving school systems in the state. These counties are less than a two hour drive from the high-tech world of the Research Triangle Park. As an outreach program of the Science House of NCSU, Team Science takes microcomputers and associated interfaces to some of these schools. Through the use of summer teaching programs, shared laboratory equipment, and increased communication and cooperation among students in these schools, we hope to provide for these rural students the same quality of science teaching that is available to their peers in the schools of the metropolitan schools of North Carolina.

6-3 TEACHERS + OCCIDENTAL = PARTNERSHIP IN SCIENCE. Chris L. Craney, Philip Hartvig, April A. Mazzeo, Tetsuo Otsuki, Grace Quimbita, Department of Chemistry, Occidental College, Los Angeles, CA 90041.

TOPS seeks to enrich high school science teaching by providing access to modern scientific equipment in the classroom. Teachers are instructed in a series of biology and chemistry experiments with a biochemistry orientation. During a two week summer program, teachers become familiar with the lab procedures, learn to use the necessary equipment, and develop lab writeups and prelab activities for the classroom. During the school year, the equipment, including gas chromatographs, spectrophotometers, computers, analytical balances, microscale kits, etc., is delivered to the school by the TOPS van. The TOPS resource teacher assists the classroom teachers in presenting the lab, which is carried out by the students. Follow-up support includes seminars, summer research opportunities and a second year program where teachers develop new experiments with the TOPS equipment.

Molecular Visualization: From the PC/Mac to the Workstation Environment, G. Bodner, Organizer — *Tuesday Afternoon*

21B-1 RESEARCH LEVEL COMPUTERS AND SOFTWARE IN THE UNDERGRADUATE CURRICULUM, Hannes Jonsson, Department of Chemistry, University of Washington, Seattle, WA 98195.

A laboratory-format upper-division undergraduate course entitled "Computations in Chemistry" has recently been established at the University of Washington. The students work with color graphics workstations and carry out various computational exercises. The first half of the course introduces algorithms that the students enter into the computer using a mathematical analysis program as a high-level programming language. In the second half, the students run larger, menu-driven programs, both commercial chemistry software and software developed by undergraduates in the Department. This paper will examine ways in which this computer teaching facility has enabled the development and implementation of new approaches to teaching.

21B-2 COMPUTATIONAL CHEMISTRY: A COURSE UTILIZING PC's TO EXPLORE *AB INITIO* AND SEMI-EMPIRICAL CALCULATION OF MOLECULAR PROPERTIES; Melvin E. Zandler, Chemistry Department, Wichita State University, Wichita, Kansas 67208

During the last few years, an exciting era of applied computational chemistry is upon us. Machines and software are emerging that allow quantum mechanical models and molecular dynamics simulations to be rapidly and inexpensively applied (at the desktop) to molecules and systems large enough to be of interest to organic, inorganic, polymer, and bio-chemists. An increasing fraction of papers in chemical journals couple experimental results with rationalizations based on molecular orbital computations and molecular trajectory studies. This presentation will survey some of the projects and examples used in an experimental course on computational chemistry presented to seniors and first-year graduate students at W.S.U. during Spring 1994, and some of the undergraduate research projects completed by some eight junior and senior students the past three years. Initial exploration of molecular properties is performed with the semi-empirical molecular orbital program, MOPAC, followed in some interesting cases by *ab initio* calculations utilizing GAUSSIAN 92. Properties computed include the standard enthalpy of formation, dipole moment, geometry (bond lengths, angles, and dihedrals), ionization potential, orbital energies, LCAO wavefunctions, bond orders and free valences, normal vibrational mode frequencies (IR and Raman spectra), *etc.*, for normal molecules, isomers, ions, and radicals, as well as transition state position and properties and features of excited state surfaces. Of great value is the ability to estimate isomerization energies and barriers and estimate the energy needed to distort molecules to a desired conformation. The intrinsic reaction coordinate feature allows firm connection between a transition state and reactant and product while the dynamic reaction coordinate feature allows molecular trajectory studies of reaction kinetics. The apparent success of this course argues for inclusion of this type of course as part of the standard chemistry curriculum.

21B-3 THE MOLECVUE PROJECT, John P. Ranck, Department of Chemistry, Elizabethtown College, Elizabethtown, PA 17022.

The Molecular Computation and Visualization in Undergraduate Education (MoleCVUE) Project seeks to create a flexible, personalized, interactive, and guided instructional environment built around a microcomputer-based student workplace. Hypertext-like instructional modules operating in this workplace shell will utilize molecular modeling, molecular visualization, animation, mathematical modeling, and graphing tools. This environment will be capable of accommodating a variety of curricular hierarchies and organizations, individual instructional perspectives, and local contexts and will serve as an atomic/molecular conceptual laboratory to accompany the traditional wet chemical and instrumentation laboratories. Most of the collaborative work on this project is being carried out via Internet. Additional workers, contributors, testers, and discussants are being sought.

21B-4 ENHANCING THE VISUALIZATION OF AN INDUSTRIAL PROCESS: DESIGN AND EVALUATION, M. A. Workman, S. R. White and G. M. Bodner, Department of Chemistry and R. G. Squires, Department of Chemical Engineering, Purdue University, West Lafayette, IN.

Computer simulations of industrial processes have been implemented in a senior-level Chemical Engineering laboratory course at Purdue University in an effort to upgrade the educational opportunities of students enrolled in a laboratory course in process design, and to enhance the students' ability to visualize a complete plant set-up and operation. Developed for use on a SUN workstation, the simulation projects use actual industrial processes, such as the Air Products Reactive Cooling of Hydrogen and Resid Hydrodesulfurization processes. This paper will combine a description of the design of the process simulations with a discussion of the effect this project has had on the students' ability to visualize industrial processes.

21B-5 MOLECULAR VISUALIZATION AND HIGH-SCHOOL STUDENTS, Sharon McCarthy, Department of Chemistry, Chicago State University, Chicago, IL

This paper will describe work done at Chicago State University to investigate the effect of using molecular modeling software, such as the CACHE system, with high-school students. Particular attention will be paid to the effect of using this software on the motivation of students while they are in the classroom, and the effect it has on their choice of careers goals.

23B-1 SUCCESSES & TECHNIQUES ASSOCIATED WITH TEACHING THE CHEMISTRY OF RADIOACTIVE WASTE. Donald H. Williams, Department of Chemistry-Hope College, Holland MI 49422-9000

In a 1-semester course for liberal arts students, they are taught the chemistry of radwaste. In this course many cooperative learning techniques and methods of student participation are used. Eight offerings show steadily improving evaluations and approaches to the course. The best approaches will be shared. Students report that they have learned more about redox, kinetics, ion-exchange, atomic structure, radiation and nuclear processes (and related material) than they ever expected to learn.

The success of this course is related to the fact that the students are involved in solving a problem that has not yet been completely worked out; one that will affect them and that presents career opportunities for people from many different specialties. Students often return to discuss energy alternatives and energy conservation indicating that strong interests have been generated.

The US Department of Energy provides abundant material for high school teaching of this material. It is my experience that theme centered courses such as this belong in the programs of science majors as well. This course is ideally suited for a multi-disciplinary approach as will be shown in the presentation.

23B-2 THE ROLE OF ATMOSPHERIC NITROUS OXIDE. W. C. Trogler, Department of Chemistry, University of California at San Diego, La Jolla, CA 92093-0358.

Nitrous oxide (laughing gas) occurs in the atmosphere at 310 ppb and it is increasing by 0.2 to 0.3% per year. This small rate of increase is significant because of the long atmospheric half-life (170 years), but the origin of the increase has not been fully explained. The only known sink for atmospheric N_2O is stratospheric photolysis and reaction with $O(^1D)$. The latter process generates NO, a free radical that catalyzes ozone depletion similar to stratospheric chlorine radicals derived from chlorofluorocarbons. The NO catalyzed conversion of ozone to dioxygen is the dominant sink for ozone in the lower stratosphere. In addition to stratospheric ozone depletion, nitrous oxide is a potent greenhouse gas with a global warming potential 270 times that of carbon dioxide. The presentation will summarize our research on mechanisms for the formation of nitrous oxide, and on possible anthropogenic sources. Nitric acid oxidation of cyclohexanol/cyclo-hexanone to adipic acid (a nylon-6,6 monomer) accounts for 10% of the global increase in N_2O. Our report led to a worldwide phase-out of these emissions.

28A-1 ATTRACTING AND NURTURING CHEMISTRY MAJORS AT TEXAS A&M UNIVERSITY. M. Larry Peck and John L. Hogg, Chemistry Department, Texas A&M University, College Station, TX 77843

At Texas A&M University chemistry majors are made to feel important. Freshman orientation/seminar is the latest addition to our curriculum. For some time we have required research and we have frequently redesigned the majors laboratory courses to reflect changing times. The numbers of scholarships and co-op and research opportunities have also increased. These efforts by the department have led to steadily increasing numbers of majors.

Details of some parts of our program will be presented.

28A-2 DESIGNING CHEMISTRY CURRICULUM FOR CHEMISTRY MAJORS AT THE UNIVERSITY OF WASHINGTON, Deborah H. Wiegand, Chemistry Department, University of Washington, Seattle, Washington 98195

Similar to other large universities, the majority of the students who take courses in the Chemistry Department of the University of Washington are majority in some area other than chemistry. Thus, efforts to examine our curriculum usually focus on the first two years of service courses that meet the needs of the engineering, pre-medicine, and other majors. Recently, however, the department began a review that emphasizes evaluating the curriculum for chemistry majors. The presentation will describe the review process as well as the results.

28A-3 ENERGY AND THE ENVIRONMENT: A MAJORS-LEVEL GENERAL CHEMISTRY COURSE, James M. Farrar, Richard Eisenberg, and Jack A. Kampmeier, Department of Chemistry, University of Rochester, Rochester, New York 14627

We have designed a new freshman chemistry course based on the themes of energy and the environment, complete with a weekly laboratory, that provides a rigorous introduction to chemical concepts, systems, and practices. The course prepares students for further study in chemistry and other natural sciences and represents a serious alternative to more traditional general chemistry courses. We use examples of important current issues and problems to motivate the science we teach, asking questions like "What chemistry do we need to know in order to understand ozone depletion?" or "What chemistry underlies global warming?" We have packaged our chemistry curriculum with a writing course offered by the philosophy department that teaches students to analyze and construct arguments, and a history course emphasizing the development of scientific thought from the beginning of the 18th century to the modern environmental movement. Approximately 40 to 50 students per year enroll in this multidisciplinary sequence that comprises our "Venture in Energy and the Environment".

28A-4
USE OF AN AQUATIC ECOSYSTEM IN UNDERGRADUATE ANALYTICAL CHEMISTRY CURRICULA. K. D. Hughes, School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, GA 30332-0400

A 300 gallon marine aquarium and experiments based on the aquarium have been incorporated into the first of a two quarter analytical chemistry curriculum. The objectives are currently three fold: (1) to provide motivation and excitement for learning and understanding traditional wet chemistry techniques by using "natural" or "real" world samples for laboratory analysis; (2) to provide evidence that solving scientific problems and difficulties drives the development of new instrumentation with improved analytical capabilities; (3) and most important, to provide visible evidence of chemistry's role in the environment and all biological processes. Students monitored the aquarium four days a week, determining ammonia, nitrite, nitrate, and phosphates by spectrophotometry, sulfate by gravimetry, dissolved oxygen, salinity, and alkalinity by redox and potentiometric methods, and calcium/magnesium by EDTA titrations. It should be noted that with this system there were no deletions in the traditional lecture content.

28A-5 CHEMISTRY MAJOR LETTER WRITING PROJECT.
Jeffrey. R. Appling, Department of Chemistry, Clemson University, Clemson, SC 29634-1905

Clemson provides an integrated first year experience for undergraduate chemistry majors. Students attend a separate section of General Chemistry, an Orientation course in the fall semester, and a specialized Inorganic course in the spring semester. A new requirement for the Orientation course is a "Letter Project," in which students write letters to successful chemists and present biographical information to their classmates. This project and its evaluation will be discussed.

28A-6 USING THE MATERIALS SCIENCE "COMPANION": PUTTING SOLIDS IN THE FOUNDATION.
Arthur B. Ellis, Department of Chemistry, University of Wisconsin-Madison, Madison, WI 53706

A resource volume entitled, "Teaching General Chemistry: A Materials Science Companion," (published by ACS Books, 1993) is being used to integrate solids into introductory chemistry courses at UW-Madison. The "Companion" demonstrates that virtually all core chemical concepts can be taught with both solid-state and molecular examples. Implementation of this approach and student and faculty response to it will be discussed.

31B-1 MODERN INTRODUCTORY LABORATORY. N.K. Kildahl and L.H. Berka, Department of Chemistry, Worcester Polytechnic Institute, Worcester, MA 01609.

At Worcester Polytechnic Institute, we have completely restructured our introductory chemistry laboratory around two major themes. First, our new program allows construction of principles from experiment, rather than verification of principles by experiment; the experiments are Discovery-based. Second, new experiments incorporate the use of modern instrumentation, to give students a state-of-the-art laboratory experience that anticipates the workplace experience. This presentation describes several of these new experiments, based on gas chromatography, electronic absorption spectroscopy, and FTIR. Students use modern gas chromatographic instrumentation to discover the active ingredient in fingernail polish remover; to measure the equilibrium vapor pressure of a pure liquid as a function of temperature; to explore deviations from Raoult's Law in binary liquid mixtures; and to identify arson accelerants. Electronic spectroscopy is used to explore the limiting reagent, reaction stoichiometry, the mole concept, chemical equilibrium, and acid-base indicators. Finally, FTIR is used to introduce students to the structures of polymers used in commercial plastic films. Introduction of this new approach to laboratory has modernized and revitalized our introductory program. We are eager to share our success with colleagues.

31B-2 MODERN INSTRUMENTATION IN THE INTRODUCTORY LABORATORY
Lee R. Sharpe, Department of Chemistry Grinnell College, Grinnell IA 50112

The Chemistry Department at Grinnell College has introduced several modern instrumental methods into its introductory courses. Experiments involving Capillary GC, FTIR, AA, Magnetic Susceptibility, and UV-Vis spectroscopy are performed. These kinds of experiments can be done in the relatively large introductory laboratories because of the technological advances in instrumentation as well as in computers. For example, with a diode-array UV-Vis spectrometer equipped with a sipper-sampler, a student can obtain a hard copy of a spectrum in ~30 seconds, allowing an entire laboratory (30 students) to obtain several spectra over the course of the lab period with only one spectrophotometer. In addition, modern instrumentation is easer to use, requires less training and supervision, and is more robust with fewer moving parts and switches/knobs reducing down time. The principal reason for bringing modern instrumentation into the introductory laboratory, however, is that it generates student enthusiasm and provides a more realistic view of what chemists really do. Specific details of experiments and instrumentation will be discussed.

31B-3 INSTRUMENTATION IN THE INTRODUCTORY LABORATORY AT LEBANON VALLEY COLLEGE. Richard D. Cornelius, Department of Chemistry, Lebanon Valley College, Annville, PA 17003.

Lebanon Valley College has sought opportunities to use chemical instrumentation at the earliest appropriate level in the curriculum. Fortunately, many types of modern chemical instrumentation can record measurements far more rapidly than their predecessors, and we can now use instrumentation on a regular basis with freshman chemistry laboratory. Our students' first experience is with an **atomic absorption spectrophotometer** to measure the sodium content of antacids. In conjunction with an experiment on freezing point depression, students record the ir spectra of unknowns on an **FTIR spectrometer**. To determining the optimal wavelength for monitoring the Fe^{3+}-SCN^- equilibrium they record spectra using a **UV-vis diode-array spectrophotometer**. And during an experiment on the pK_a of organic acids, they use **FT-NMR** to record the carbon-13 spectra of their unknowns.

We give students a basic introduction to the information that the instrument provides and to the techniques for handling samples. We set up the instrument for use, and the professor or an assistant is present to explain the procedures, but students perform all of the steps necessary to obtain data on their samples. For example, freshman individually insert and remove from their NMR tubes from the superconducting magnet. We find that the use of the instrumentation enhances the experiments and also sparks interest on the part of the students.

31B-4 REAL SAMPLES AND MODERN INSTRUMENTS - A PAIRING THAT WORKS.
Jack K. Steehler and Vernon R. Miller, Department of Chemistry, Roanoke College, Salem, VA 24153-3794

At Roanoke College, our introductory courses have added a significant flavor of real life applications of chemistry in the lecture portion of the course. To accompany this flavor in the laboratory, we have added a number of real sample analysis experiments, including a crime solving lab, an air pollution project, a water pollution project, and an experiment studying a leaking toxic waste container. In each case, the most true-to-life analytical method is used, most likely an instrumental method. Our students use GC, HPLC, Atomic Absorbance, and several other techniques in these experiments. Even though we have only one copy of each major instrument, the speed of modern instruments allows a full section of students to do the experiment in a normal lab period. Practical aspects such experiments will be discussed, along with student responses.

Increasing the Use of Writing in Chemistry Courses *Tuesday Afternoon*
H. Beall, Organizer

38C-1 COMMUNICATION AND CHEMISTRY: A STOICHIOMETRIC COMPOUND? J. Edmund White, Department of Chemistry, Southern Illinois University at Edwardsville, Edwardsville, Illinois 62026, and Betty E. White, Department of English, Murray State University, Murray, Kentucky 42071

One result of interest at SIUE in the Writing-Across-the-Curriculum (WAC) movement is the university-wide requirement that all beginning-level General Education courses "incorporate significant written communication" and that this writing component "must carry a significant portion of the course grade." Assignments to meet this requirement were designed collaboratively by professors of Chemistry and English and used in four offerings of CHEM 111, Contemporary Chemistry. The results will be analyzed with respect to the cost in faculty time and the benefits for the students; issues related to institutional support for WAC efforts will also be discussed. The whole effort will be interpreted from the viewpoint of composition theory.

38C-2 MAKING CONNECTIONS: USE OF STUDENT JOURNALS IN GENERAL CHEMISTRY.
Anna G. McKenna, Department of Chemistry, College of St. Benedict/St. John's University, St. Joseph, MN 56374.

A great deal of effort has been focused on ways to help students make connections in General Chemistry. For example, it is difficult for students to relate their laboratory experiences to classroom experiences, and more difficult for them to connect topics discussed in class with previous knowledge acquired in Chemistry and other disciplines. I have successfully used student journals in General Chemistry to aid students in making these connections. In both General Chemistry I and General Chemistry II, students write regular journal entries in which they reflect on important topics from class and the relationship of these topics to the laboratory experiments and previous knowledge. This writing technique, along with examples of student writing and course evaluations, will be discussed in this presentation.

38C-3 INTER-DISCIPLINARY WRITING IN ANALYTICAL CHEMISTRY. Daryle H. Fish and Caryl L. Fish, Saint Vincent College, Latrobe, PA 15650

As part of an interdisciplinary writing program at Saint Vincent College, three analytical chemistry courses have been taught as writing designated classes. The goal of this program is to increase skills in critical thinking and written expression. The program also has set standards for evaluation based on the six principles; clarity, purpose, organization, insight, coherence, and support. The types of writing assignments are somewhat different in each of the courses. In quantitative analysis the assignments center around interpretation of data from student laboratory work. The writing assignments in instrumental analysis were based on case analysis in which the students were given an analytical problem and had to determine the best instrumental method. In the methods of environmental analysis, teams of students wrote proposals,laboratory notebooks, and final reports for four environmental projects.

38C-4 WRITING ASSIGNMENTS FOR TEACHING QUANTUM CHEMISTRY, Lorrie Comeford, Department of Chemistry and Physics, Salem State College, Salem, Massachusetts 01970

Traditionally, physical chemistry texts present only a brief discussion of the controversial nature and historical context of quantum chemistry. In order to introduce these issues into the discussion of quantum chemistry, the book **In Search of Schrodinger's Cat: Quantum Physics and Reality** was used as a supplemental text. The students wrote essays in response to the reading. The assignments helped students to think more deeply about quantum chemistry, provided a measure of the students' understanding, stimulated class discussion, and served as a forum in which to discuss the way theories are developed.

38C-5 A SCIENTIFIC WRITING/COMMUNICATION COURSE FOR CHEMISTRY MAJORS

Elizabeth Winter Wolpaw
Chemistry Department, Siena College, Loudonville, NY 12211 (Bitnet: Wolpaw@Siena.Bitnet)

Good writing and communication skills are essential in every area of chemistry. We have introduced a required, one-credit course for senior chemistry majors to enhance their skills in written and oral communication. The core of the course is the students' preparation of a complete paper, written in standard scientific research paper format, describing an independent research project or a laboratory course project. On a given day, each student comes with a draft of one section of her/his paper, with copies for everyone, and together we read and critique these drafts. We concentrate both on scientific writing conventions and on general writing skills. Students then rewrite their samples for submission to the instructor. Other assignments include preparation of a curriculum vitae, again with group discussion and critique. We also discuss the elements of effective oral presentation. Each student makes an oral presentation on a laboratory research project. In addition, we discuss and practice oral communication skills in preparation for job interviews. Students find the workload heavy in this course but they appreciate gaining skills with direct application to their post-graduate professional and academic endeavors.

48A-1 ORGANIC CHEMISTRY AS A LIBERAL ART. Seyhan N. Ege and Brian P. Coppola, Department of Chemistry, University of Michigan, Ann Arbor, MI 48109-1055.

Mechanistic organic chemistry is now being used as the context in which first year students at the University of Michigan are introduced to many of the important concepts in chemistry. The emphasis in these courses, lecture and laboratory, is to convey ideas about how chemists think about molecular phenomena, how they develop models, and how these models evolve as experimental data accumulate. When taught in this way, organic chemistry develops the skills that are traditionally associated with study in the liberal arts. The philosophical underpinnings of such an approach and some of the results of teaching organic chemistry in this way will be discussed.

48A-2 NEW WINE IN OLD BOTTLES: A DECADE OF STRATEGIES THAT HAVE HELPED REVEAL THE VALUE OF ORGANIC CHEMISTRY TO OUR STUDENTS. Brian P. Coppola, Seyhan Ege, Department of Chemistry, The University of Michigan, Ann Arbor, Michigan, 48109.

Our *Structure and Reactivity* sequence uses contemporary, mechanistic organic chemistry as the context for providing students with the beginning of some important learning tools. Unlike most of their previous experiences in chemistry, a year of organic has well-defined and unifying principles that build to a very sophisticated predictive tool, spiraling out and up from a reasonably easy beginning. New skills must be developed in order to be successful. In our experience, this very unfamiliar type of learning in a science course benefits from explicit attention to the metacognitive issues in order to move student expectations towards ours. The most important strategy we have developed is to make examinations reflect the skills we want to reinforce, to prevent the use of undesired skills, and to reshape classroom instruction to meet these goals. In this session, we will present some of the ways we have squeezed some new flavor into the venerable vintage of organic chemistry.

48A-3
THE FIRST YEAR LAB COMPONENT OF THE U OF M CURRICULUM AT LOCK HAVEN UNIVERSITY, R.W. Kleinman, Department of Chemistry, Lock Haven University, Lock Haven, PA 17745

The laboratory component of the first year of the University of Michigan chemistry curriculum has been successfully implemented at Lock Haven University, part of the State System of Higher Education in Pennsylvania. A comparison of teaching the lab component at the two universities - one a research university and the other a comprehensive -niversity - will be presented. Some of the advantages and disadvantages of implementing the laboratory component at the two universities will be discussed. The different student populations will also be compared. The philosophy behind the laboratory component will be presented to show that with the right faculty attitude, students can benefit regardless of their background or where the course is offered.

48A-4 LITERATURE-BASED COURSE WORK AND LAB WORK.FOR SCIENCE-MOTIVATED FIRST-YEAR STUDENTS. Brian P. Coppola, James Hovick, Department of Chemistry, The University of Michigan, Ann Arbor, Michigan, 48109.

As part of the *Structure and Reactivity* sequence, students in the first term course are offered the option of a more research-based section of the second term course. About 90-100 students self-select their way into this course. In addition to attending a lecture that includes issues in experimental design, students have a weekly journal assignment that moves them from identifying and communicating representative examples of the chemistry they see in class to learning about various library resources. An instructional goal in this course is the most significant skill we have identified: can a student be presented with new factual information and create meaning from it. The final examination culminates the work: a group of unfamiliar journal articles, a set of leading questions, and two hours. In the lab, the traditional techniques-based approach is replaced by an unresolved research project where students must become comfortable with the uncertainty of research work.

48A-5 GRADE/PERFORMANCE CONTRACT AND COOPERATIVE LEARNING INTERVENTIONS IN UNDERGRADUATE ORGANIC CHEMISTRY
R.C. Dougherty, Dept. Chemistry, Florida State University, Tallahassee, Fl. 32306-3006

The average success rate over the last five years for undergraduate organic chemistry at Florida State has been approximately 50% per term. Abandoning work on the subject after one or two poor exam performances caused much of the failure. In Spring and Summer, 1993 we introduced a series of interventions in undergraduate organic chemistry. A control section provided standards for both retention and performance on a standard ACS organic examination. Students in the experimental section submitted homework and quizzes as part of a cooperative study group. Students in the experimental section had enhanced communication with the instructor through open office hours and electronic mail. They were offered a grade/performance contract that guaranteed a minimum grade of C- if the provisions of the contract were met. These provisions included transcription of lecture notes into a bound notebook, regular attendance and problem solving, and appearance for interviews after poor exam performances. Over the two-term sequence approximately three times as many students succeeded in the course than expected from the past five years performance. The average percentile score for the experimental course on the ACS organic exam was more than three standard deviations above that of the control. Implementation of this program requires more teaching effort than standard lecture instruction. Improved retention justifies this effort.

48A-6 THE ORGANIC CHEMISTRY LECTURE: WHAT HAPPENS WHEN THE INSTRUCTOR CHANGES THE MODE OF DELIVERY? Richard C. Bauer, George M. Bodner, and Kirsten A. Lowrey, Department of Chemistry, and G. Marc Loudon, Department of Pharmacy and Pharmacological Sciences, Purdue University, West Lafayette, IN 47907.

Much of the recent literature in chemistry education has focused on the inadequacy of the traditional lecture mode of content delivery. There are many problems with the lecture mode of delivery -- most importantly, the students are passive during class meetings. The authors investigated an organic classroom in which the instructor utilized a discussion format, rendering the students more active during class meetings. During class periods, students were involved in class discussions that revolved around the questions the instructor posed. By using a discussion format the instructor focused the students' attention on key concepts. During class meetings students were encouraged to communicate their ideas, make connections between concepts, and solve problems. In this paper, the authors describe what occurred during the course of the semester -- the general environment in the classroom, the questions the instructor asked, and the curricular implications of using a discussion format in the lecture session.

48A-7 A MECHANISM FOR INVOLVING ORGANIC STUDENTS IN THEIR OWN LEARNING.
Linda M. Sweeting, Department of Chemistry, Towson State University, Baltimore, MD 21204.

Students in Organic Chemistry must learn both new study skills and new concepts of chemical problems and their solution. To improve their mastery, approximately one quarter of the "lecture" classes become collaborative learning experiences in which the students work problems in small groups with the instructor as wandering coach. Several methods are used to extract the time from the traditional lecture format. These problem sessions provide significant improvement in the students' understanding of nomenclature, resonance effects, and mechanistic principles and details.

48A-8 A Tour of the Revitalized Organic Lab Program at Penn State. Robert D. Minard, Chemistry Dep't., Penn State University, University Park, PA 16802

Since 1988, several improvements in the organic lab program have been made:

1) The development of an "individualized experiments" approach that allows the 700-800 students that annually take introductory organic chemistry to analyze their synthetic products using modern instrumentation (NMR, IR, UV/VIS, MS, GC-MS, GC, HPLC, polarimetry and refractometry); 2) The creation of a undergraduate Chemistry Resource Center Instrument Room that houses these instruments in a central facility to be utilized by all lab courses (general, organic, analytical, physical); 3) The restructuring of the Advanced Organic/Inorganic Preparations course to fulfill the "writing-across-the-curriculum" course requirement for chemistry majors; 4) The development of a number of special enzyme-based experiments for a bioscience version of the introductory organic labs. 5) The remodeling of the organic laboratories including a special desk level "sit-down" lab for development of "ChemTrek" style experiments. 6) The establishment of a structured TA training program and the production of an in-house instructor's manual. These and other improvements will be presented.

Geochemistry in the Classroom, R. Jones, Organizer *Tuesday Afternoon*

50-1 GEOCHEMISTRY IN GENERAL CHEMISTRY. John D. Hostettler, Chemistry Department, San Jose State University, San Jose, CA 95192-0101

This paper considers the uses of geochemistry as examples, problems, topics and themes in the general chemistry course. At the very least, it will be argued, geochemistry can provide very interesting and illuminating real world examples and problems. Furthermore, it will be argued that geochemical topics belong in the general chemistry course and that geochemical themes can be used to structure the descriptive chemistry in the second semester. These points will be illustrated with examples drawn from the author's course.

50-2 AN UNDERGRADUATE PROGRAM FOR TRAINING ENVIRONMENTAL TECHNICIANS, Susan M. Libes, Marine Science Department, Coastal Carolina University, P. O. Box 1954, Conway, SC 29526

Increasing legislative controls on pollution have given rise to a large need for water quality monitoring. To address this, an undergraduate B.S. program was developed to train students for careers as environmental technicians. This interdisciplinary program provides a rigorous background in physics, biology, chemistry, geology, calculus, and statistics. The environmental chemistry component covers atmospheric, aquatic, marine, and geological topics. As part of their training, students receive hands-on experience in an Environmental Quality Laboratory certified by the state. This laboratory was established with financial support from NSF. As part of their laboratory experience, students learn how to use standard QA/QC procedures as well as EPA-approved methodology. Methods for sample collection and the design of sampling programs are covered. Career planning is also provided.

50-3 USING GEOCHEMISTRY TO PUMP UP ACS STUDENT AFFILIATE
Rudolph B. Jones, Essex County College, 303 University Avenue, Newark, New Jersey 07102.

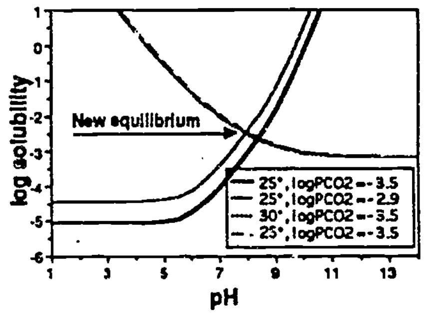
Students love to do what they perceive as real chemistry or unique chemistry. Along those lines two activities have been designed. One activity involes examining a river at various points for various substances. The other activity involves the dying of agates. Handouts with sources, methods and formulas available.

50-4 GEOCHEMISTRY FOR CHEMISTS. John D. Hostettler, Chemistry Department, San Jose State University, San Jose, CA 95192-0101

Geochemistry courses are usually offered as upper division or graduate courses in geology departments. Thus, few chemists take geochemistry or know much about it. This paper describes an upper division two semester course, "Geochemistry for Chemists", which attempts to educate chemists on the geological aspects of their discipline. The course starts with rocks and minerals and then progresses to the formation of the earth and the rock cycle. Chemical topics in the course include solid state, nuclear, thermodynamic, acid-base, redox, and organic chemistry. Hopefully, the nature of geochemistry and its relationships to other subdisciplines of chemistry such as environmetal and industrial chemistry will be clarified.

50-5 A GRAPHICAL SOLUTION TO AQUEOUS CARBONATE EQUILIBRIA C.S. Kirby, Geology Dept., Bucknell University, Lewisburg PA 17837; M. A. Williamson, Adrian Brown Consultants, 155 S. Madison St., Suite 302, Denver CO 80209-3014; J. D. Rimstidt, Dept. of Geological Sciences, Virginia Tech, Blacksburg VA 24060-0420

Carbonate equilibria play an important role in many natural systems. A graphical solution is presented with environmental applications. An exercise is designed for secondary and undergraduate students which can help to teach the importance of the carbonate system, the addition of chemical equations, the effect of temperature and P_{CO2} on calcite ($CaCO_3$) solubility in seawater. Chemical equations and equilibrim constants are first presented, then equations and the common logarithms of the equilibrim constants are added to show solubility relations with pH. The exercise can be completed with or without the use of computer spreadsheets and graphing programs. Two applications included are a global warming scenario and a hydrothermal reinjection example. This approach can also be modified to teach the concepts involved in the hydrolysis of metals in solution. A copy of the exercise will be available on request.



What is Chemical Education Research?
P. Metz, Organizer

Tuesday Afternoon

52-1 WHAT IS CHEMISTRY EDUCATION RESEARCH? Patricia A. Metz, Department of Chemistry and Biochemistry, Texas Tech University, Lubbock, TX 79409-1061.

Interest in chemistry education is on the rise. Each year we see more academic positions in C&E News advertising for someone with expertise in the area of chemistry education. Also several universities have established or are in the process of establishing advanced degree programs in chemistry education. Chemists in general understand the need for such positions and programs but they often do not understand the research done by these individuals. The goal of this symposium is to inform our colleagues about the kinds of research done in chemistry education. This talk provides an introduction to and a background for the symposium.

52-2 Unexpected Aspects of Quantitative Research. Susan C. Nurrenbern and William R. Robinson; Department of Chemistry, Purdue University, West Lafayette, IN 47906

Quantitative research in chemical education usually involves testing the hypothesis that students improve in some quantifiable way as a consequence of changes in lecture, laboratory, or some other variable feature of the educational process. The issue of the statistical significance of the results often stands out as the important component of such studies; however, there are other considerations of equal importance. We will discuss some underlying principles that provide the foundation for the appropriate design of a quantitative experiment.

52-3 CHEMICAL EDUCATION RESEARCH USING THINK-ALOUD METHODS. Craig W. Bowen, Center for Instructional Development and Research, Parrington 109, DC-07, University of Washington, Seattle, WA 98195

Data collection using think-aloud techniques involves asking subjects to describe their thinking as they solve problems or explain concepts. Typically subjects are recorded as they are interviewed individually. The researcher's role is to ask probing questions of a subject if he or she stops thinking aloud, or if the researcher is unsure about a particular process or concept the subject uses. Transcriptions of the interviews serve as a pool of data where an analysis frequently involves aggregating statements from within individuals' transcripts with the goal of trying to describe their thought processes or conception of ideas. Often researchers using think-aloud techniques generalize across several of the subjects with the goal of formulating a general model of thinking in a given content domain (e.g., solving organic synthesis problems). This methodology is most appropriate in new areas of research on student thinking because it allows researchers an opportunity to understand what kinds of thinking students might be doing.

52-4 QUALITATIVE METHODOLOGIES IN CHEMICAL EDUCATION RESEARCH: CHALLENGING COMFORTABLE PARADIGMS. Amy J. Phelps; Department of Chemistry, University of Northern Iowa, Cedar Falls, IA. 50614-0423.

If the intent of an investigation is to examine phenomena from the perspective of the participants as they go about doing what they do, then a qualitative methodology would be the most appropriate research model to employ. Qualitative methods are well suited for attending to the uniqueness of individuals within a particular situation and understanding the meanings individuals attach to particular actions. This is an especially useful approach if one is trying to improve the teaching and learning of chemistry. Without a clear understanding of how what we are currently doing impacts students, we may be at a loss to make any real improvements. Qualitative research provides rich, descriptive data about the contexts, activities, and beliefs of participants in educational settings. The approach can be used for evaluation. for descriptive research, and for theoretical inquiry. Issues of validity, reliability, sampling and data collection, and analysis for this type of research paradigm are dealt with in a manner very different from traditional experimental research.

52-5 OVERCOMING THE SPORTS MENTALITY: ACTION RESEARCH AS A METAPHOR FOR CURRICULUM EVALUATION. George M. Bodner and Daniel L. MacIsaac, Department of Chemistry, Purdue University, West Lafayette, IN 47907-1393

At a recent NSF-sponsored conference, one speaker noted that projects to revitalize the introductory course in his discipline had evolved through pilot-testing to full implementation at several institutions. He then noted that it would be a good idea to evaluate the effect of this curriculum reform on the students who take the course, but wasn't sure how this could be done. Another speaker noted that new curriculum materials in his field were going to be evaluated by comparing student performance in two sections at the same institution, one taught by an individual using the classic curriculum materials and another taught by someone using the new approach.

It was abundantly clear that our colleagues in science and mathematics are ill-equipped to evaluate curriculum materials they develop, and, when they finally get around to doing evaluation, they can't seem to escape a sports-mentality metaphor, which assumes that one team has to win while another loses. This paper will describe an alternative approach to research designed to evaluate changes in curriculum known as action research and show how it might be used.

52-6 THE USE OF SURVEYS AND QUESTIONNAIRES IN CHEMISTRY EDUCATION RESEARCH.
J. R. Pribyl, Department of Chemistry and Geology, Mankato State University, Mankato, Minnesota 56002-8400

Surveys and questionnaires do have a place in chemistry education research. These tools enable the researcher to investigate trends and characteristics that are present within a population. The advantages and disadvantages of these tools will be discussed. Appropriate applications as well as practical suggestions for the implementation of surveys and questionnaires will be described.

52-7 CHEMICAL EDUCATION RESEARCH IN THE LABORATORY ENVIRONMENT: HOW CAN RESEARCH UNCOVER WHAT STUDENTS ARE LEARNING? M.B. Nakhleh, Department of Chemistry, Purdue University, West Lafayette, IN 47907-1393.

Laboratory work is often considered an essential component of any science course, yet little research has investigated how students actually learn in a laboratory environment. Students seem to experience difficulty in integrating their understanding of chemical concepts gained in lecture with the physical phenomena observed in the laboratory. A laboratory is a complex, information-rich environment, and perhaps students simply become overwhelmed in their efforts to process the information effectively. This paper will discuss appropriate methodologies for conducting research on laboratory learning. This paper will also discuss two techniques, concept mapping and V-diagramming, which can be effective research tools in probing students' understanding of chemical principles. These techniques can also be effective instructional tools to aid students in integrating their lecture knowledge with their laboratory observations. Illustrative examples will be drawn from several studies.

52-8 RESEARCH ON COMPUTERS IN CHEMISTRY: A SHORT PRIMER. B. James Hood, Department of Chemistry and Physics, Middle Tennessee State University, Murfreesboro, TN 37132.

Computers have been used in the chemistry classroom for almost 50 years and we have seen the technology advance to the point that our ability to represent microscopic chemistry has been realized. It is important, however, that in the rush to develop novel and engaging computer-based instructional materials, we must carefully assess the effectiveness of these programs. Educational research methods can successfully be applied to this task. During the development phase, qualitative research methods can be used to gather and analyze data that will help the developer determine design issues that may detract from or enhance the students learning, while quantitative methods can help the educator decide whether the program is less, equally, or more effective than more traditional instructional methods. This presentation will provide a short review of the critical aspects of educational computing research and a demonstration of the application of research methods to virtual reality tutorial development.

52-9 CHEMICAL EDUCATION RESEARCH. Diane Bunce, Department of Chemistry, The Catholic University of America, Washington, DC 20064; Dorothy Gable, School of Education, Indiana University, Bloomington, IN 47405; J. Dudley Herron, Department of Physical Sciences, Morehead State University, Morehead, KY 40351-1689; Loretta Jones, Department of Chemistry and Biochemistry, University of Northern Colorado, Greeley, CO 80639.

This paper is a report of the Chemical Education Research committee, an ad hoc committee of the Division of Chemical Education, which was appointed to define chemical education research. Using the categories of scholarship outlined by Ernest Boyer in his 1990 Book, Scholarship Reconsidered: Priorities of the Professorate, the committee describes scholarship in chemical education; draws attention to differences between the scholarship of teaching and the scholarship of discovery, integration, and application in chemical education; and contrasts research in chemical education with more conventional research in chemistry.

Conversation: Coping with a Dual Assignment: Chemistry-Physics, -Biology, -Math, D. Slattery, Organizer *Tuesday Afternoon*

7-1 HANDLING MULTIPLE TEACHING ASSIGNMENTS: ONE HIGH SCHOOL TEACHER'S PERSPECTIVE. D.L. Slattery, Danville Area High School, Danville, PA 17821

While prepared and trained to teach high school Chemistry, in small rura' schools, chemistry teachers are often called upon to also teach Physics, Biology, Physical Science or Earth Science. This is one such teacher's suggestions on how to set your teaching priorities, organize your time and resources and survive the day to day challenge.

7-2 CONVERSATION ON HANDLING MULTIPLE TEACHING ASSIGNMENTS. Kristen H. King, Science Department, Selinsgrove Area High School, North Broad Street, Selinsgrove, Pennsylvania 17870

Multiple teaching assignments are commonplace to me. As a rookie teacher I had to deal with a new environment and two unfamiliar courses and texts. Preparing for a week's lesson involved reading the text, writing notes, preparing labs and activities, and creating worksheets, quizzes and tests. Although this is expected of every teacher I had to start from scratch to make each lesson my own. In addition to this I had many additional duties such as supervision of study halls, the library, dining room and hallways. Along with the courses from last year another lab course was added to my schedule. Because of these experiences I feel that I am qualified to be a participant in the Conversation on the Handling of Multiple Teaching Assignments. The keys to success with many preps are careful planning and time management.

7-3 SCIENCE EDUCATION IN THE SMALL HIGH SCHOOL. Bruce Koloseike, Hanover High School, Hanover, NH

The reality for the science teacher in a small high school will be that he or she may be required to teach more than one of the sciences or mathematics as part of the normal team teaching load. In the very small high school, there may be only one science teacher working in life science, earth science, chemistry and physics. By creative scheduling and curriculum adjustments, the opportunity for small classes and the challenge of an integrated curriculum are possibilities. The problems of certification and communication are real. Experiences with physics and chemistry will be used as examples.

7-4 INTERDISCIPLINARY TEACHING, Ildy V. Boer, Department of Biology/Chemistry, County College of Morris, Randolph, New Jersey 07869

Our world is complex and interrelated. In today's academic environment no discipline should be isolated. This talk will focus on two interdisciplinary endeavors at the County College of Morris. Our college offers a team taught history course entitled Civilization and Technology. As a member of this team, I taught the Biology, Medicine and Chemistry unit of this course. As a tenured member of the Biology-Chemistry Department and the Mathematics Department, my assignments include a mathematics course offered to future chemical and biological technicians. These technologies involve numerous calculations and problem solving techniques needed for both future course work and the industrial environment. Traditional high school and college courses do not provide the specific preparation needed. A chemist is able to bridge this gap.

Teacher Education and the High School Curriculum, P. L. Samuel, Organizer — *Tuesday Afternoon*

57B-1 A MODEL FOR PROFESSIONAL DEVELOPMENT IN A CHEMISTRY TEACHER TRAINING PROGRAM. Cheng-Hsia Wang, Department of Chemistry, National Taiwan Normal University, Taipei, Taiwan

Learning is situated. People learn from acting in authentic contexts. Therefore, practice in the actual situation of teaching is essential to become a good teacher. This paper reports how we use a unit development approach as opportunities for prospective chemistry teachers to: (a) examine their beliefs and values about responsible citizen action on STS issues; (b) find a place of STS in school science education; (c) confront inconsistencies in their beliefs and values about STS action through participating in STS unit development, and (d) construct more appropriate beliefs, values, and corresponding science teaching practices. Scaffolded instruction has moved the prospective teacher toward independence in instructional strategies. A model with five learning phases have been synthesized in this study out of the works of Marzano and Waks to aid in improving the quality of teaching and learning in C-STES (learning chemistry through science, technology, environment, and society) units. A structured interview was performed to identify trouble spots and help develop teaching practices. The effectiveness of the professional enhancement through an C-STES unit development for prospective chemistry teachers was evaluated by comparing: (1) the C-STES unit developed at the entry level with the improved unit at the exit level; (2) the unit task analysis and interpretations made by the subject at entry with exit levels, and (3) the peer assessment of microteaching performances. The results of this study show that the C-STES unit development improved the participant's professional performance. Acknowledgment: The financial support from the ROC National Science Council is greatly appreciated.

57B-2 SEX AND THE STUDENT TEACHER. Wallace J. Gleekman, Brookline High School, Brookline, Massachusetts 02146

A budding introduction into the sensuous world of student teaching for the neophyte who wishes to taste the nectar of chemistry teaching. May also be used by older and wiser more experienced teachers to stimulate the exploration of new ways to do old things. This program, rated R, investigates the many facets that should be sampled before plunging headlong into a long, serous and involved commitment. The diverse adventures that could be pursued are examined in detail with minute attention paid to increasing responses on a week-to-week basis. The climax, of course, results in ultimate exposure. Samples of this exposure will be made available to participants.

57B-3 DEVELOPING A STATE-WIDE NETWORK OF CHEMISTRY TEACHERS
Richard J. Miller and Arden P. Zipp, Chemistry Department
SUNY Cortland, Cortland, NY 13045

Working in collaboration with the New York State Education Department the authors established a network of lead chemistry teachers in 1992. The purpose of this network is to improve the knowledge base and quality of instruction of the more than 2000 secondary school chemistry teachers in New York State. This has been achieved by providing the thirty lead teachers (mentors) with information about recent developments in chemistry and chemical education through a week-long Summer Institute and two-day meetings during the year. Each mentor is expected to conduct a minimum of two workshops for teachers in his/her local area during each academic year. The success of the program, which is supported by funds from the Dwight D. Eisenhower Program of the U. S. Department of Education, will be described

57B-4 IN-SERVICE INSTRUCTION FOR CHEMISTRY TEACHERS -- A UNIQUE PROGRAM IN MISSISSIPPI. John H. Bedenbaugh and Angela O. Bedenbaugh, Box 8466, University of Southern Mississippi, Hattiesburg, MS 39406-8466

We have developed and are currently modeling a program with the capability of providing career-long continuing education in chemistry (with college credits) to all high school chemistry teachers on a statewide basis. Instruction is provided by teaching teams at multiple sites at full-day meetings of regional associations of chemistry teachers. Our presentation will include details about development or selection of materials, administration of the program, assessment of implementation of instruction, and determination of grades for the course. Plans for testing the adaptability of this program in West Virginia will also be discussed. Our instructional program is supplemented by a resource center housing printed materials, video tapes, computer software, etc. A toll-free telephone number enables chemistry teachers from across the state to request materials on loan and to ask questions of the university faculty member who directs the Center. A newsletter, distributed statewide semiannually, provides teachers with project news, announcements, and information about professional opportunities.

57B-5 *CHEMCOM* CULTIVATES DECISION-MAKING SKILLS. Rebecca J. Mason Simmons, Education Division, American Chemical Society, Washington, DC 20036

High school chemistry teacher(s) who are using the course *Chemistry in the Community* (*ChemCom*) developed by the American Chemical Society, will discuss the uniqueness of the decision-making activities used in *ChemCom*. Discussions will include an short introduction to the philosophy and goals of the course, followed by a presentation/demonstration of several types of decision-making activities found in *ChemCom*. The *ChemCom* course emphasizes problem-solving and decision-making skills, and is built around several types of student activities that are seldom found in conventional chemistry courses. These activities include three levels of decision-making exercises, all of which require student participation and cooperation for success. Participants will be encouraged to participate and will take home handouts of the activities presented.

ChemCom is a year long chemistry course designed for college-bound high school students. It emphasizes the impact of chemistry on society by addressing chemistry-related technological issues that are relevant to the community and society in which the student lives.

57B-6 SALTERS' ADVANCED CHEMISTRY: A REVOLUTION IN PRE-COLLEGE CHEMISTRY. D. W. Denby, Neil Heeley, John Leggott College, West Common Lane, Scunthorpe, South Humberside, DN17 1DS

Salters' Advanced Chemistry, developed at the University of York, England, provides a unique approach to teaching Chemistry through the ways that Chemistry is used and the work that chemists do. The course has been running in the U.K. for four years and has been thoroughly revised following extensive trials. In this talk teachers who are using the course will explain why they and their students find it so attractive. Included in the session will be up to date information about using Salters' Advanced Chemistry in an American context.

57B-7 FILLING THE PIPELINE: THE ENVIRONMENTAL MANAGEMENT PRECOLLEGE ANALYTICAL CHEMISTRY PROGRAM (EMPAC). Joan A. Miller, EMPAC Program Manager, Associated Western Universities, Inc., 4190 S. Highland Dr., Ste. 211, Salt Lake City, Utah 84124

The Environmental Management Precollege Analytical Chemistry Program (EMPAC) is conducted each summer on HBCU, minority and inclusive university campuses across the United States. The overall program goal is to motivate high school students, especially those from underrepresented groups, to pursue science and engineering-based curricula and careers. Able high school sophomores, juniors and seniors with at least one year of high school chemistry take, for transferable college credit, a university-level summer course in environmental analytical chemistry. Students pursue a rigorous daily lecture and laboratory schedule; guest speakers, lecturers and field trips emphasize environmentally related topics. The course is taught by experienced analytical chemistry faculty. High school chemistry teachers participate as laboratory instructors, mentors and role models for the students. Results indicate more than half the students will elect more chemistry courses; half will major in a science or engineering discipline; students feel confident and able to succeed in the college environment.

57B-8 A NAIVE APPROACH TO ATOMIC AND IONIC RADII

Herb Bassow, Germantown Friends School, Philadelphia, PA 19144

A naive approach to calculation of atomic and ionic radii, using the work of Barlow (W.Barlow, Sci.Proc.Roy.Dublin Soc. 8,527,1893-8) and the Braggs (W.H.Bragg & W.L.Bragg, Proc.Roy.Soc. A88,428,1913, and W.L.Bragg, ibid,89,248,1913).

Tha amazing story behind the one part in 500 errors in the classic experiments of four Nobel Laureates (W.H. & W.L. Bragg, Siegbahn, Millikan), as well as pre-1930 values of the Avogadro number, will be told and fully documented (Herb Bassow, J.Chem.Ed., 68,273, Apr. 1991), as well as linked to the naive approach described above.

Teaching Tips, P. L. Samuel, Organizer — *Tuesday Afternoon*

57C-1 AVOIDING MISCONCEPTIONS COMMONLY ENCOUNTERED IN HIGH SCHOOL AND COLLEGE CHEMISTRY TEXTS AND COURSES. John M. DeKorte, Department of Chemistry, Northern Arizona University, Flagstaff, AZ, 86011

There is a tendency to believe that there is an inherent stability associated with noble gas configurations, that dispersion forces are the weakest type of Van der Waals forces for small molecules, that the conjugates of weak acids and bases are strong bases and acids and that spontaneity is related to whether chemical reaction actually occurs. Come, examine and discuss these commonly encountered misconceptions.

57C-2 THE BONDING IN THE OZONE MOLECULE FROM A NON-RESONANCE POINT OF VIEW. Michael Laing, Department of Chemistry, University of Natal, Durban 4001, South Africa.

A new qualitative treatment of the bonding in the ozone molecule is presented. It is based upon a combination of several simple concepts; the non-participation of the pairs of electrons tightly held in the atomic 2s orbitals of the oxygen atoms; simple overlap of the 2p orbitals to form sigma bonds; interaction of three 2p orbitals to yield bonding and non-bonding pi molecular orbitals that are populated by electron pairs; and van der Waals repulsion between the two terminal oxygen atoms forcing these atoms apart to yield the bond angle of 117° as a compromise. Both the assumptions and the resulting bonding picture are in accord with the photoelectron spectroscopic data, the results from sophisticated molecular orbital calculations, and the common physical properties of ozone.

57C-8 A TETRAHEDRON OF BONDING TYPES. Michael Laing, Department of Chemistry, University of Natal, Durban 4001, South Africa.

Crystalline solids are commonly classified as: Metallic; Ionic; Covalent network; van der Waals, Molecular, with their well known characteristic physical properties. There are advantages in representing these four types of bonding as the apexes of a tetrahedron. Appropriate extreme examples would be: Copper; NaF; Diamond; Iodine. The weak van der Waals forces that hold together a crystal of solid iodine are reflected in the ease of sublimation of iodine, while the three-dimensional network of strong covalent carbon — carbon bonds accounts for the extreme hardness of diamond. Other different crystalline solids can be assigned a place along the various edges of the tetrahedron appropriate to the bonding in the solid. For example, ZnS would lie on the Covalent-Ionic edge; Selenium (Se_8) would be on the van der Waals-Covalent edge; Gallium (Ga_2) is assigned to the Metallic-van der Waals edge. This representation of the four classes of the bond as the apexes of a tetrahedron allows a self-consistent classification of bonding in solids and hence of their accompanying physical properties.

57C-3 STUDENTS EXPLAINING CHEMICAL DEMONSTRATIONS: AN EXPERIMENT WITH PROBLEM SOLVING AND COOPERATIVE LEARNING IN GENERAL CHEMISTRY. David K. Erwin and James P. Rybarczyk, Department of Chemistry, Rose-Hulman Institute of Technology, Terre Haute, Indiana 47803

Students enrolled in the freshman general chemistry course at Rose-Hulman Institute of Technology are exposed to a number of learning techniques that attempt to further their problem-solving skills and their experience with cooperative learning groups. During the last week of class, the instructor presents several common lecture demonstrations that illustrate many of the basic chemical concepts. Students are asked to formulate explanations for these demonstrations in their cooperative learning groups. Groups are randomly selected to present their explanations in front of the class and to address questions from their peers and the instructor. Details and results of this exercise will be presented.

57C-4 THE NEWSPAPER AS A CHEMISTRY TEXTBOOK. Rein U. Kirss, Thomas R. Gilbert, Dept. of Chemistry, Northeastern University, Boston, MA 02115

Increased concern for establishing relevant connections between introductory undergraduate chemistry courses and the world outside of the classroom is a recurring theme in chemical education. To this end, a number of textbooks have been published in the last few years including *ChemCom, Chemistry in Context, The Extraordinary Chemistry of Ordinary Things* and *Why Chemistry?* With few exceptions, standard textbooks include appendices or special sections in each chapter devoted to establishing the connection between the chemistry and the world. Nevertheless, these materials remain textbooks and are viewed by students as such. In the past two years, we have introduced the newspaper as a true "non-textbook" medium for establishing a context for studying chemistry. The newspaper and related non-technical periodicals are utilized in two ways: (1) Term papers where the student is asked to find a newspaper article that involves the chemistry discussed in lectures; (2) Presentation of chemical principles in the context of how they appear in news stories and, magazine articles from non-technical periodicals. Specific examples of how such sources are applied to introductory chemistry and samples of student writings will be presented.

57C-5 EXTRA CREDIT AS A CARROT FOR THE USE OF E-MAIL. Carl H. Snyder, Department of Chemistry, The University of Miami, Coral Gables, FL 33124.

E-mail has been used for student-instructor communication in four chemistry classes: 1) a set of three classes of a course for nonscience students, and 2) one semester of a course of organic chemistry for science majors. The nonscience students were offered a carrot of extra credit for submitting test questions. In one term they were given the option of submitting questions on paper or via e-mail, with a bonus for e-mail submission; in two terms only e-mail submissions were accepted. The organic students were given no extra credit for the use of e-mail, but were encouraged to use e-mail as a supplement to office visits. In effect, the organic students served as a control for the carrot given to the nonmajors. The frequency of the use of e-mail by students in these four classes is correlated with their class standing.

57C-6 WORKSHOP CHEMISTRY AT THE CITY UNIVERSITY OF NEW YORK. David K. Gosser, Jr. and Michael Weiner, Chemistry Department, The City College of the City University of New York, New York, NY 10031

The Chemistry Department at the City College has explored new teaching methods that enhance student participation. The City College model, "Workshop Chemistry", moves away from the lecture mode and introduces new roles for students in both the learning and teaching process. Each week the class breaks up into small workshops: small groups of students that work together under the guidance of a workshop leader. The workshop leaders are students who have done well in the course previously. Statistics collected since 1991 indicate that participation in the workshop improves performance in General Chemistry. We also note benefits to the workshop leaders, a diverse group who gain a sense of community through working together with the faculty. The workshop style course structure is now being employed in the Chemistry for Health Science course and Biochemistry. The presentation will emphasize practical issues of implementation of workshops as well as what we have learned about teaching through the use of workshops.

57C-7 C.C.N.Y. WORKSHOP PROGRAM IN CHEMISTRY. Stanley R. Radel and Millicent Roth, Chemistry Department, The City College of the City University of New York, 138 St. and Convent Ave., New York, N. Y. 10031.

At least three first-year chemistry workshop programs have been tried at the City College. This presentation will describe two models: (1) an optional two-hour workshop program to develop problem-solving skills and (2) a mandatory supplemental workshop program involving a mix of model building, graphing, and problem-solving skills. Each workshop involves no more than 10 students -- broken into two subgroups of 5 students -- working together with a trained student leader. The presentation will describe training of workshop leaders, workshop implementation, cost in both dollars and time, and student reaction and performance.

59-3 TIPS FROM THE NSF: PROGRAMS IN UNDERGRADUATE AND PRE-COLLEGE EDUCATION. Stanley H. Pine, Donald E. Jones, Susan H. Hixson, National Science Foundation, Arlington, VA

The National Science Foundation supports a variety of programs to promote undergraduate and pre-college education. The Foundation encourages science faculty at all levels to participate in these programs to bring innovation, change, and excellence to the student learning experience. Program Directors will discuss currently available areas for support and provide guidance for submitting successful proposals.

59-1 RESOURCES TO MAKE LIFE EASIER FOR CHEMISTRY TEACHERS. Martha K. Turckes; American Chemical Society, 1155 Sixteenth Street, NW, Washington, DC 20036.

The American Chemical Society's Office of High School Chemistry administers programs and produces materials for high school chemistry teachers and students. This session will focus on the newest products available to high school chemistry teachers from ACS. Portions of three videotapes (on safety, demonstrations, and careers) will be previewed. Other products available from the office will be discussed such as *Chemunity News*, a free newsletter to chemical educators; *ChemMatters*, a magazine for high school students; the travel grant program, whereby teachers can receive travel money to attend an ACS or NSTA meeting; and *ChemSource*, a new must-have resource for all high school teachers. Come and see what's new and exciting in the world of chemical education!

59-6 FROM THE LOCH NESS MONSTER TO THE KILLER LAKE OF CAMEROON: INTERESTING QUESTIONS IN SCIENCE. Ron DeLorenzo, Middle Georgia College, Cochran, Georgia 31014

Enjoy applying scientific principles to obtain new and unusual insights like deducing the temperature of Hell, learning why underwear explodes, and determining the proper way to open a beer can. Additional topics include: Why is electricity free in the winter, why do Iowa algae bury themselves before Cape Cod high tides, how can sand be used to restore eyesight and hearing, and why does the Loch Ness Monster immediately dive after surfacing?

S-1 COST-EFFECTIVE STRATEGIES FOR CHEMICAL EDUCATION - RETROSPECT AND PROSPECTS. Krishna V. Sane, Department of Chemistry, University of Delhi, Delhi - 110 007, India

Escalating costs of apparatus/chemicals and rising enrollment of students, are responsible for an ever increasing reliance on the "chalk and talk" method for teaching chemistry in the developing countries. If the excitement and relevance of learning chemistry is to be brought back in the classroom, it is necessary to identify activity-based approaches which are cost-effective. Since non-availability of low-cost, simple and reliable equipment which is easy to fabricate and easy to maintain is one of the major obstacles for improving chemistry teaching in developing countries, the Committee on Teaching of Chemistry (CTC) of IUPAC initiated, in association with UNESCO, a project in 1979 at the Department of Chemistry, University of Delhi. The fifteen year old project has shown that a variety of solutions are possible based on locally available materials and electronic components. The Delhi University project has also gone beyond the problem of equipment by initiating work in microprocessor-controlled instrumentation, educational software, computer interfacing, Desk Top Publishing, audio-visual aids, and small-scale chemical techniques.

CTC and UNESCO, with the help of various international, regional and national agencies, have conducted over 50 hands-on workshops all over the world where selected teachers are trained in the fabrication and use of equipment and other items developed under the CTC/UNESCO project. These workshops have led to the formation of Core Groups in different countries who are adapting the CTC/UNESCO work to suit local needs. An International Network for Locally Produced Low Cost Equipment (LPLCE) has now been setup with headquarters at Delhi University to facilitate exchange of ideas and dissemination of the know-how.

The Indian component of the LPLCE programme, exclusively supported by local funding, is attempting to carry the academic exercise to its logical conclusion by organizing nation-wide teacher training courses followed by appropriate changes in the laboratory curricula. A notable feature of the Indian effort is the setting up of a manufacturing unit for supplying LPLCE items to educational institutions. The Unit employs handicapped personnel and school dropouts and it is managed by a charitable Society. The coupling of educational and social objectives has enabled the Delhi University Project to equip more than 200 student laboratories at affordable costs.

To summarize, several educational and technological innovations originating in the developed countries are capable of transforming the chemical education scene in developing countries in a self-reliant manner if the innovations are (a) adapted to local situations (b) disseminated through in-service and pre-service teacher training programmes (c) coupled to curriculum changes and (d) supported by a semicommercial manufacturing/supply system.

15B-1 VISCHEM - DEVELOPMENT OF MULTIMEDIA RESOURCES IN CHEMISTRY.
R. F. Tasker, Department of Chemistry, University of Western Sydney - Nepean, Sydney, Australia 2747

Understanding chemistry involves being able to link what one sees in the laboratory to what one imagines is happening at the invisible molecular level. Only then can these ideas be communicated meaningfully using abstract symbolism, terminology and mathematics. The VisChem Project has developed multimedia resources (animations, video, and sound) to explicitly link these three levels - the molecular, laboratory, and representational. Targeted at students who are entering a science-based university course with a poor background in chemistry, they are designed to replace static, 'hand drawn' and OHP molecular diagrams presently used by educators.

The resources have also been integrated into a Mac CAL program that educators can edit, supplement and complement according to their needs and resources, thus engendering 'ownership' and commitment to the program's delivery. Students can set their own preferences (eg. choice of foreign accent in text voiceovers) and learning style (eg. choice of guided progression or freedom to 'jump' material). The prototype evaluation phase of the project has just finished.

15B-2 COMPUTER-ASSISTED LECTURES IN ORGANIC CHEMISTRY. Betty A. Luceigh, Ph.D., Department of Chemistry and Biochemistry, University of California, 405 Hilgard Avenue, Los Angeles, CA 90024-1569.

Dynamic Visualizations for Introductory Organic Chemistry (CHEM TV for the Mac) have been utilized in a large lecture setting to approximately 3000 students over the past two years. The computer-generated animations are primarily used to visualize organic structures and chemical processes, but group interactive modes have also been incorporated. Examples will be demonstrated. The integration of the computer as an effective tool within the framework of more traditional methods has altered the presentation style and influenced the focus of the subject material. An evaluation of the impact on learning organic chemistry based on student surveys and personal observations will be described. The experiences of presenting a computer-integrated lecture and the direction of new technology has stimulated questions and suggestions for teaching organic chemistry in the 21st century.

15B-3 PROTEINS, AN INTERACTIVE MULTIMEDIA PROGRAM FOR THE MACINTOSH.
Barbara K. Whitmarsh, University of Illinois, Department of Chemistry, 601 S. Mathews, Box A-2, Urbana, IL. 61801

Proteins is a multimedia computer program developed to assist the chemistry instructor in the classroom. Two dimensional and three dimensional structures of amino acids, substructures of proteins and proteins are organized in an interactive presentation format, following the order of most introductory textbooks. Key graphics including rotations and animations can be accessed through menu bars allowing the instructor to directly select specific parts of the program. The second stage includes an interactive problem solving program to be used by the students on their own. While students will be viewing some of the same structures presented in lecture, they will have to answer questions designed to increase their understanding of the underlying concepts.

15B-4 NMR COMPUTER ASSISTED LAB INSTRUMENT OPERATION AND PRINCIPLES EXPLANATION (NMR-CALIOPE) Robert D. Minard, F. Cusack, A. Demark, M. Heddaeus, B. Nelson, M. Trecoske, M. Whittaker Chemistry Dep't., Penn State University, University Park, PA 16802

NMR-CALIOPE is instructional software that combines guidance in the operation of an NR-80 FT-NMR spectrometer with data acquisition/analysis based on the TecMag MiniMacSpec™ system. It is designed to allow hundreds of sophomore-level organic chemistry lab students to carry out NMR analysis of synthetic products on a "walk-up" basis without continuous supervision. It is NOT an NMR instrument simulation. The program, created in MacroMedia Director™, guides students through: 1) Principles of NMR spectroscopy, 2) Introduction of the NMR sample tube and locking the magnetic field; 3) Tuning the instrument to optimize sample signal (shimming); 4) Acquiring the data (FID); 5) Processing the data (fourier transforming, phasing, integrating, plotting) and 6) special techniques for advanced users, such as variable temperature.

Environmentally Friendly Laboratory Experiments, W. Harwood, J. Delfiner, Organizers — *Tuesday Evening*

22-1 CANDY CHROMATOGRAPHY, R.W. RODRIGUEZ, NORTH ROCKLAND HIGH SCHOOL THIELLS NY 10984

I have taken Marie Sherman's work with ICE and adapted one of her activities. Elementary teachers were presented with this activity at an in service workshop presented at my school district during this long winter. The course stressed hands on activities, and the teachers' participating were very pleased with this activity.

Maria Haluska rewrote the procedures. The demonstration takes about 20 minutes and results occur within that time. We will use M&M's Reeses Pieces and Skittles separating the dyes in the colors of these candies using a salt water solution as the carrier.

The colors of the candies are not always what you or your students think they are. If there are any left over candies please help yourself.

22-2 FOUR LAB ACTIVITIES USING NATURAL INDICATORS. Maria A. Haluska, The Ursuline School, 1354 North Avenue New Rochelle N.Y. 10804

The four labs: "The Stubborn Egg", "Nature's Own Indicators", "Environmental Art" and "Be a pH Detective", were designed to use the same set of easily available and environmentally-safe vegetable extracts. This cluster of labs minimizes teacher preparation time; models reuse to the student; explores buffers as well as indicators. The lab write-ups stress making observations, careful data recording, creation of charts and making generalizations. "The Stubborn Egg" is a natural egg-dying lab illustrating the persistent buffering effect of the shell. "Nature's own indicators" is a high school level pH determination lab. In "Be a pH Detective" the student makes pH test paper. In "Environmental Art", the students "paint" masterpieces which transform with exposure to acidic and basic environments.

22-3

AN ENVIRONMENTAL CHEMISTRY LABORATORY COMPONENT FOR NON-SCIENCE MAJORS. Margaret M. Condron and Lynne A. O'Connell, Department of Chemistry, Boston College, Chestnut Hill, MA 02167.

We are incorporating a laboratory component into the environmental chemistry course for non-science majors offered at Boston College. Experiments which convincingly illustrate specific environmental problems concretely drive home the chemical principles and also motivate individuals to take responsibility for environmental protection. In lieu of a full laboratory component, a trio of carefully selected experiments has been chosen which will significantly enhance the knowledge, attitudes and practices of students. In the first experiment, students explore the effects of air pollution through the generation and analysis of acid rain samples. Global resource depletion and recycling is illustrated through a second experiment which demonstrates aluminum recovery. Lastly, students perform a series of tests on water samples to determine the presence and levels of substances which are relevant to health concerns and EPA drinking water standards. Challenges arising from the diversity in student backgrounds will be discussed and student feedback presented.

22-4 A "NINE BOTTLE" TYPE LAB EXERCISE WITH NO HEAVY METAL WASTE.
Claire R. Olander, Appalachian State University, Boone, North Carolina 28608

Traditional schemes for lab exercises based on metathesis reactions employ heavy metal ions, such as, silver, barium, and lead. In this exercise, only calcium, manganese, aluminum, and sodium cations are used. The anions, nitrate, carbonate, hydroxide, chloride, and thiosulfate are equally innocuous. This exercise may be modified to be more or less challenging. I use it in a course designed for non science majors.

22-5 A CONVENIENT, INEXPENSIVE, AND ENVIRONMENTALLY-FRIENDLY METHOD OF MEASURING THE VAPOR PRESSURE OF A LIQUID AS A FUNCTION OF TEMPERATURE. James H. Burness, Department of Chemistry, The Pennsylvania State University, York Campus, 1031 Edgecomb Ave., York, PA 17403 717-771-4096

The measurement of the vapor pressure of a liquid as a function of temperature is a standard experiment for laboratory courses from the high school to the university level. The experiment is attractive because it provides a practical application of the Clausius-Clapeyron Equation, gives reasonably accurate results, and requires the students to prepare and interpret graphical data. Unfortunately, significant disadvantages include the use of mercury manometers and the need for large volumes of water to operate aspirators. This paper describes the results of an experimental modification which permits students to measure vapor pressures with hand-held vacuum pumps, thereby eliminating the use of mercury manometers and water aspirators. Another advantage to the modified approach is that data collection is much faster. The accuracy and precision of the data collected by both the original and the modified procedures will be compared.

22-6 PYROLYSIS OF IRON PYRITE: AN INTRODUCTORY STOICHIOMETRY EXPERIMENT Alfred J. Lata, Department of Chemistry, University of Kansas, Lawrence Kansas 66045, and William G. Davies, Department of Chemistry, Emporia State University, Emporia Kansas 66801

The pyrolysis of iron pyrite proves to be an effective stoichiometry experiment for the beginning student. The experiment utilizes a naturally occurring mineral (Ward's Natural Science Establishment, Inc.), has no waste disposable problem, and yields suitable data that can be interpreted in a variety of manners. Although simple in procedure, the experiment takes time in heating and cooling, as well as the necessity to bring a crucible, as well as the product, to constant weight. The preparation of the finely divided iron pyrite presents some problems.

The experiment and various interpretations will be discussed, as well as the results. Problems with sample preparation will also be presented.

22-7 AIR STREAM ASSISTED MICROSCALE SUBLIMATION. Prem D. Sattsangi, Department of Chemistry, The Pennsylvania State University, Fayette Campus, Uniontown, PA 15401.

Sublimation as a purification tool has been largely ignored in undergraduate teaching due to constraints of time, requirement of specialized apparatus, and availability of the vacuum line in student laboratory.

A new, quick and practical approach to sublimation in the microscale using the Micro/Mini-Lab Kit will be presented, and results of its application on a variety of compounds will be discussed.

Computer Interfacing Instrumentation in Advanced Undergraduate Laboratories, P. Rasmussen, Organizer — *Tuesday Evening*

32-1 RAPID ESTIMATION OF RADON LEVELS WITH COMPUTER-INTERFACED GEIGER COUNTERS. Ralph W. Sheets and Clifton C. Thompson, Department of Chemistry, Southwest Missouri State University, Springfield, MO 65804

Indoor/outdoor radon concentrations and working levels (WL) can be estimated rapidly and conveniently by using moderately priced microcomputer-interfaced Geiger counters. In this technique air is drawn through a glass fiber filter on a high volume air sampler for 5 minutes. After a 1-minute post-sampling interval, the radiation counter, covered with a 0.010-inch thickness of aluminum, is placed in contact with the filter and the beta dose rate is measured for 10 minutes. The average dose rate during this period is directly proportional to the WL collected on the filter. From this WL value the ambient radon concentration can be estimated. WL's determined by this method were found to agree to within $\pm 10\%$ with WL's measured simultaneously by the standard three-count (modified Tsiviglou) method. WL's of less than 5×10^{-4} (corresponding to radon concentrations < 0.10 pCi/L) are readily determined.

32-2 LIMSPORT: COMPUTERIZED DATA ACQUISITION AND STANDARD SPREADSHEETS. Tom Betts and Ed Vitz, Department of Physical Sciences, Kutztown University of Pennsylvania, Kutztown, PA 19530

The chemistry labs at Kutztown University are taking advantage of computerized data acquisition with a general, low-cost, high performance system called LIMSport (*L*aboratory *I*nformation *M*anagement *S*ystem capable of im*port*ing data directly into a standard spreadsheet). We have developed an array of sensors (pH, temperature, conductivity, absorbance, etc.) that can be constructed in house at minimal cost. The LIMSport system provides the user with software that controls data acquisition through the computer's game port and other I/O devices, and places the data in a standard (Lotus) spreadsheet. Through NSF-funded workshops we have been able to help other chemistry departments incorporate this system into their laboratories. We are currently developing a general approach to adapt the LIMSport system to other Windows-based spreadsheets.

32-3 CONSTRUCTION AND TESTING COMPUTERIZED GENERAL CHEMISTRY EXPERIMENTS IN AN ADVANCED UNDERGRADUATE COURSE. Kenneth E. Hyde, Neil Bonzagni, Matt Hach, John Parsons, and Todd Warakomski, Department of Chemistry, State University of New York, College at Oswego, Oswego, NY 13126

During the Fall 1993 semester the focus of our upper level elective "Microcomputers in the Chemistry Laboratory" was redirected. Students construct and test simple interfacing circuits and probes that are useful for the computerization of general chemistry laboratory experiments. Software development is minimized by the use of LOTUS 1-2-3 and the LIMSport data acquisition macros developed at Kutztown University. The second portion of the laboratory course is project driven. Traditional laboratory experiments are converted to computerized versions. Data acquisition is automated and the laboratory report emphasizes the use of spreadsheets for data analysis and display.

32-4 VIRTUAL INSTRUMENTATION. D. Ritter, Department of Chemistry, Southeast Missouri State University, Cape Girardeau, MO 63701

Two virtual instruments have been constructed in our Physical Chemistry laboratory. The first is a virtual autotitrator based on an Orion pH meter, a 386 CPU computer, and a homemade stepper-motor driven syringe. A graphical user interface written in Visual Basic allows the user to control the system with simple mouse clicks. The program automatically set up a link to a Quattro Pro for Windows spreadsheet and pokes each pH value and number of steps into the proper spreadsheet cells. The user manipulates the data in the spreadsheet to generate first and second derivative curves to determine the endpoint, and produce the graphical output. The second is a stopped-flow spectrometer interfaced to a 386 CPU computer which uses a virtual oscilloscope program written in Visual Basic to collect and display the data. Students use a spreadsheet to manipulate the data and compare fits to simple models.

32-5 DATA ACQUISITION IN THE INSTRUMENTAL ANALYSIS LABORATORY USING LABTECH NOTEBOOK AND LOTUS 1-2-3. Adam T. MacLuckie, Rebecca A. Hegner and Paul W. Rasmussen, University of Pittsburgh, Pittsburgh, PA 15260.

Labtech NOTEBOOK is perhaps the commonest visual programming tool for data acquisition in the chemical industry. Methods have been developed in NOTEBOOK for logging to disk the output from analytical instrumentation in the instrumental analysis undergraduate laboratory. The data is then imported into Lotus 1-2-3 where it is analyzed, presented, printed and archived using a menu of macros. The macro system is designed as an example of semi-automatic data analysis, but also has provision for data security, quality control charting, and grading based on student results.

Posters: General, P. L. Samuel, Organizer *Tuesday Evening*

58C-1 **A COMPREHENSIVE REVISION OF THE INTRODUCTORY CHEMISTRY COURSE**
David E. Henderson and Henry A. DePhillips, Chemistry Department, Trinity College, Hartford, CT 06106

An approach to teaching introductory chemistry is described which incorporates a large number of changes from the traditional course. Details of the course structure and topics covered will be presented.

1. **The course is completely laboratory driven.** - Laboratory data is brought to the classsroom to develop general principles from specific observations.
2. **The course makes extensive use of computational chemistry (Personal CAChe).** - Molecules and their physical and chemical properties are developed with simple organic molecules. Chemical reactions and stiochiometry are then developed using combustion reactions.
3. **Student project labs** - Topics include acids in commercial products, vitamin C in foods, the oil content of various margarines, and the Acid Rain Project.
4. **Extensive writing is required.** - Writing occurs in both the lab and classroom settings.
5. **Collaborative learning is emphasized in the laboratory and classroom.**
6. **The topic coverage is designed to maximize student appeal.** - Topics and examples related to food, biochemistry, and the environment keep student interest high while teaching basic principles.

Examples of computational chemistry (CAChe) projects will be available for examination along with the course materials developed locally to support this approach.

58C-2 INTERPRETING CHEMICAL INFORMATION FROM THE LAY PRESS AS ESSAY EXAM QUESTIONS IN LARGE SECTIONS OF GENERAL CHEMISTRY. James Laughlin and Karen E. Eichstadt; Department of Chemistry, Ohio University, Athens, OH 45701

Over 800 students in General Chemistry were asked to interpret chemical "errors" from the lay press through an essay question on each exam of the course. An analysis of their responses provides insights into their interpretation and ability to express chemical ideas. Examples of appropriate questions will be presented with a systematic analysis of responses. Grading techniques for large numbers of essay papers will also be included in the presentation.

58C-3 WRITING ASSIGNMENTS AND COOPERATIVE LEARNING EXERCISES FOR A GENERAL CHEMISTRY COURSE. M. L. Arthur, Department of Chemistry, Ashland University, Ashland, OH 44805

Brief writing assignments and cooperative learning exercises contribute 15 - 25% of the course grade in one section of general chemistry at Ashland University. Representative activities conducted during a two-semester course will be discussed. Writing assignments emphasize description and comparative analyses. Topics are selected that integrate lecture and laboratory material. Cooperative learning exercises take place during class time. Groups of two-to-four students obtain experimental data and interpret the results. Conclusions which are consistent with the data are emphasized. Student feedback in terms of interest in the course and increased learning will be discussed.

58C-4 PLACING STUDENTS IN GENERAL CHEMISTRY SEQUENCES. TEN YEARS OF USING THE 1981 ACS TOLEDO EXAM. Wesley E. Bentz and J. Robert Pipal. Division of Chemistry, Alfred University, Alfred NY, 14802

For the past ten years the Division of Chemistry at Alfred University has given the 1981 version of the ACS Toledo exam to all students taking our year long general chemistry sequences. We have used this as an advising tool to place students in a preparatory course, in the regular year long sequence, or in our advanced version of the year long sequence. We recently switched from using the students' performance on the exam as an advising tool to using it as a prerequisite. The presentation will review our student scores, our criterion for using the scores to place students, and the success of the endeavor.

58C-5 PREDICTING STUDENT PERFORMANCE IN LIBERAL ARTS CHEMISTRY
David Fraley & David Forman -- Depts. of Chemistry & Education
Georgetown College, Georgetown, KY 40324

Liberal Arts Chemistry courses have become popular in the last 20 years for non-science students to gain a perspective on modern chemical science. This course is designed for students majoring in the humanities, fine arts, business, or education who do not need the more mathematical and theoretical approach that General Chemistry texts take.
What does it take to succeed in the Liberal Arts Chemistry course? What predictors (such as ACT or SAT scores, high school performance, or prior college performance) accurately indicate how a student will perform? This pilot study identifies those variables that best predict a student's performance in Liberal Arts Chemistry, namely HS-GPA, HS-Class Rank, HS-Chem Grade, ACT-Science Reasoning, and ACT-English. The strikingly poor correlation of the ACT-Math score is in direct contrast with its very strong correlation to predict success in General Chemistry. Net: council at-risk students early on ways for them to achieve success in Chemistry.

58C-6 TESTED DEMONSTRATIONS AND SELECTED DEMONSTRATIONS IN CHEMISTRY FROM THE JOURNAL OF CHEMICAL EDUCATION. George L. Gilbert, Department of Chemistry, Denison University, Granville, OH 43023

This text is a revision of the well-received *Tested Demonstrations in Chemistry* book by H. N. Alyea and F. B. Dutton which collects demonstrations published in the *Journal of Chemical Education* through 1990 in the Tested Demonstrations Feature as well as selected demonstrations published elsewhere in the Journal. The discussion will share the goals, problems and resultant materials obtained during the selection and editing processes.

58C-7 ON STUDENTS' LACK OF COMPREHENSION OF THE NATURE OF IONS: A SIMPLE SUGGESTION FOR AUTHORS OF GENERAL CHEMISTRY TEXTS. Gary P. Wulfsberg, Department of Chemistry, Middle Tennessee State University, Murfreesboro, TN 37132.

One of the most important concepts that we try to teach in General Chemistry courses (and beyond) is the nature and reactivity of inorganic ions, and especially the nature of ionic equilibria. Students, however, have major difficulties in even recognizing the presence of ions in the formulas of ionic compounds, let alone in recalling the formulas and charges of polyatomic ions, or in converting molecular forms of equations to net ionic forms. The usual textbook presentations of these processes either rely on memorization, which is notoriously short-term, or have many steps that implicitly depend on concepts that the student cannot have had at that point. By expanding considerably on these implicit steps in lecture, we have succeeded in raising student performance on a post-test (conducted early in the second semester) of ability to write net ionic equations and aqueous ionization processes from an 8% success rate to 16%. This dismal "improvement" leads us to propose a simple alternative to textbook authors and editors: **leave the charges on (and the parentheses about) the ions in the formulas of ionic compounds** in the first half of the textbook! Then students can learn simple and polyatomic ions the way they learn the names of the common elements and their positions in the periodic table: not by memorizing them, but by seeing them over and over again.

58C-8 THE CARCINOGENIC ACTIVITY OF BENZO(a)PYRENE. William E. Adams, Dept. of Chemistry & Physics, Salem State College, Salem, MA 01970.

This lecture is given to Nursing majors in the second semester of a two semester sequence of General (1st semester), organic & biochemistry (2nd semester). The purpose of this lecture is to show there is a lot of chemistry in biology and particularly their bodies. For four weeks prior to the lecture they have studied saturated, unsaturated and aromatic compounds.Thus, they are becoming comfortable with structural formulas. Also, during the four weeks they have had several encounters with the physical property of water solubility and the relationship between structure and water solubility.

This presentation will describe what is discussed in class and how the students handle this special topic.

58C-9 VISUALIZING PARTIAL DERIVATIVES IN THERMODYNAMICS. Hugh A. Ewart. Chemistry Department, SUNY College at Oswego, Oswego, NY 13126

Students studying thermodynamics for the first time can usually grasp the significance of the total differential but often have difficulty visualizing partial derivatives such as the partial of P with respect to T at constant H, the Joule-Thomsen coefficient. The properties of a simple geometrical object will be used to illustrate these relationships.

58C-10 THE USE OF POLYANILINE AS AN ELECTROACTIVE MATERIAL FOR A SUPERCAPACITOR. Marie Reluga, East Catholic High School, Manchester, CT 06040-1898

This presentation describes work done by the author during a U.S. Department of Energy/TRAC research appointment at Los Alamos National Laboratory.

58C-11 LEARNING THROUGH PARTICIPATING IN C-STES UNIT DEVELOPMENT. Cheng-Hsia Wang, Department of Chemistry, National Taiwan Normal University, Taipei, Taiwan

This study is to design a model to: (1) guide preservice teachers to develop (a) unit of C-STES (learning chemistry through science, technology, environment, and society) for the grade 7 through 12 students, and (b) its related STS data-base; (2) promote teachers abilities in (a) learning how to learn and absorb new knowledge, (b) instructing and assessing students' learning abilities, and (c) doing active research (science teachers as active researchers); and (3) stimulate science education reform through STS teaching and achieve STS literacy for all citizens in our country with social and global views. Scaffolded instruction has moved the prospective teachers toward independence in the unit development. A model of five learning phases has been synthesized in this study out of the works of Marzano and Waks to aid in improving the teacher's instructional strategies. A structured interview was performed to identify troubled spots and promote the teacher's professional development. The learning achievements of the subjects provided evaluation results that the unit activities of the developed unit are useful in promoting teachers' instructional and assessment abilities and the students' knowledge of related STS topics. Acknowledgment: The financial support from the ROC National Science Council is greatly appreciated.

58C-12 THE UNIVERSITY OF TENNESSEE, KNOXVILLE PRE-COLLEGE SCIENCE OUTREACH PROGRAMS. Al A. Hazari, Department of Chemistry and Arlene A. Garrison, College of Engineering, University of Tennessee, Knoxville, TN 37996

The University of Tennessee Department of Chemistry and the College of Engineering are conducting several science outreach programs for area K-12 students and teachers. Financial support is provided by Title II/Eisenhower, American Chemical Society, Institute for Chemical Education, Hoechst-Celanese Corporation and several local organizations.

58C-13 TQM IN THE CLASSROOM. USING QUALITY CIRCLES TO IMPROVE GENERAL CHEMISTRY COURSES. Leonard S. Kogut, Penn State Beaver Campus, Brodhead Road, Monaca, PA 15061

Quality circles have been used as a technique to improve quality and productivity in the industrial setting for approximately fifteen years in the United States. Although applications in higher education are increasing, use of the quality circle in classrooms, particularly in Chemistry, is rare. This paper describes how quality circles have been used to advantage in several General Chemistry courses. Procedures for implementation are presented. Among several benefits circles provided in these cases was feedback to the instructor, which guided course modification. Student reaction to the circles and the impact of the circles on the other students are also discussed. Quality circles have the potential to address a variety of issues in the chemistry classroom.

58C-14 WHY DID THERMODYNAMICS SEEM SO CONFUSING? BECAUSE IT IS! (BUT NEED NOT BE)
L. J. Sacks, Christopher Newport University, Newport News, VA 23606

Thermodynamics has evolved over the past two centuries from total confusion through a sequence of misunderstandings of fundamental processes concerning energy transfer. While the understandings have been clarified to a considerable extent, particularly in practical applications, the structure through which they are presented is still based to a significant degree on poorly defined terms and convoluted logic. It is no wonder that many capable potential scientists are turned away by the current presemntations! (And how many of us "got through" thermo by accepting the results, rather than understanding, the concepts?). This paper will reconsider such fundamental terms as energy, heat, temperature, entropy, and "reversible process", and both the verbal and mathematical statements which are alleged to represent these. A different approach is offered.

58C-15 THE EFFECT OF STRUCTURAL/TAXONOMIC RULES ON THE IDENTIFICATION/NAMING OF COMPOUNDS BY SCIENCE COLLEGE STUDENTS. Moises Camacho, Dept. of Natural Science/Math, Inter American University of P.R., Aguadilla Campus, Box 20, 000, Aguadilla, P.R. 00605

This study investigated the ability of 75 science college students to identify and name simple General Chemistry compounds whose nomenclatures is covered in General Chemistry I. A preliminary pilot study was made with about 100 students from which the 75 subjects were pooled. By using the think-aloud interview and a simple test it was shown that almost all subjects lacked basic knowledge of the classes and nomenclature of General Chemistry Compounds. The nature, classification, and taxonomic rules were taught and practiced with 3 experimental groups. Group 1 had completed one semester of General College Chemistry, group 2 had completed four courses of College Chemistry, and group 3 had completed three courses of College Chemistry.

At the end of the semester a simple test was administered in which the mean scores were respectively 26.0, 36.0 and 26.0 for groups 1, 2 and 3. The two control groups had mean scores of 9.2 and 9.3.

P-4 RENEWABLES AND THE ENERGY FUTURE. Helena Chum, Director, Industrial Technologies Division, National Renewable Energy Laboratory, 1617 Cole Boulevard, Golden, CO 80401

Innovative Teacher Education Programs, P. Hill Organizer *Wednesday Morning*

9A-1 AN INQUIRY-BASED APPROACH TO PRESERVICE ELEMENTARY TEACHER EDUCATION IN CHEMISTRY. Brian P. Coppola, James Hovick, John Lakanen, Joseph Krajcik, Department of Chemistry, School of Education, The University of Michigan, Ann Arbor, Michigan, 48109.

Three years ago, we introduced our first chemistry course for a cohort of 24 preservice elementary teacher education students who are also co-registered in a separate elementary science methods course, an education psychology course, and who also partcipate in a directed field experience. The chemistry course has evolved into a very student centered effort, where the overarching goal is to provide future teachers with the tools they need to pursue and understand questions that might arise in connection with chemistry topics. In the lecture portion of the course, students were provided with a set of leading questions as in-class work, then as take-home work, only after which more formal instruction was provided. During the term, the leading questions moved from being provided by the instructor, to being self-generated, to being solicited from actual elementary students. The laboratory portion of the course focused on a breadth simple physical and chemical changes. In the associated methods course, students could raise the question of how to take ideas from the chemistry course and represent them in an elementary classroom.

9A-2 TEACHING SCIENCE WITH TOYS--AN ACTIVITY-BASED PRE-SERVICE COURSE, John P. Williams, Chemistry Department, Miami University-Hamilton, Hamilton, OH 45011, Arlyne M. Sarquis, Chemistry Department, Miami University-Middletown, Middletown, OH 45042, and Jerry L. Sarquis, Chemistry Department, Miami University, Oxford, OH 45056.

As an extension of our in-service TOYS workshops for grade K-12 teachers, we taught a parallel pre-service course for undergraduate education majors for the first time in the Spring semester of 1994. The course met in two-hour blocks twice a week. A chemist and a physicist alternately taught the four chemistry and four physics units with inquiry-based activities using toys as scientific tools. The chemistry units were "Substances and their properties"; "Mixtures and their separation"; "Physical states of matter"; and "Chemical reactions." Details of course mechanics and evaluation will be presented. Funding has been provided by the National Science Foundation, the Ohio Board of Regents, Miami University, and Cincinnati Section ACS.

9A-3 EFOS-A LAB SCIENCE INTENSIVE CURRICULUM FOR ELEMENTARY EDUCATION MAJORS, Patricia S. Hill and Roger B. Wilson, Department of Chemistry, Department of Elementary and Early Childhood Education, Millersville University, Millersville, PA 17551.

Elementary Focus on Science (EFOS) is a recently designed science curriculum which will provide elementary education majors the option of enhancing their science background while completing their degree requirements within the standard 124 credits. Students electing this option will complete introductory courses in biology, chemistry, earth science, math and physics. In addition students will select two more advanced science courses in an area or areas of their choice and complete a "capstone" interdisciplinary course entitled "Technology and Its Impact on Humans". The majority of the required and optional science courses involve laboratory work and sections of these courses will be reserved for all elementary education majors selecting this option. The program is co-chaired by faculty from the schools of science and mathematics and education. Details of the program will be described.

9A-4 DEVELOPING AN INTEGRATED SCIENCE COURSE FOR ELEMENTARY EDUCATION MAJORS. Thomas E. Bitterwolf, Steven D. Gammon, Mickey E. Gunter, Robert J. Kearney, Marc J. Klowden, David J. Oliver, Department of Chemistry, University of Idaho, Moscow, ID 83843

Amidst the ongoing public debate on the problems in math/science education very little attention has been focused on the nature of the science preparation being received by elementary education majors. A typical curriculum calls for these students to take two or three, introductory level courses in science disciplines. While this background is consistent with most core requirements, it fails to acquaint future teachers with the broad sweep of science, and fails to model the integrated approach to the teaching of science. In response to these problems associated with the traditional methods to teaching pre-service teachers science, an NSF supported program/course titled "Integrated Science for Elementary Education Majors" is being developed by science and education faculty at the UI in partnership with local school districts. This presentation will discuss the objectives, organization, content and developmental issues associated with the creation of a truly integrated science course targeted just at elementary education majors.

9A-5 EXPERIMENT IN COLLABORATIVE LEARNING: PROGRESS REPORT. Mary A. Dugan, Dept. of Chemistry, Immaculata College, Immaculata, Pennsylvania 19345.

Immaculata's core-within-the-core program provides a common base of knowledge, skills and values and attempts to respond to fragmentation in learning. This experiment in collaborative learning consists of three one-semester courses taken at the freshman, sophomore and junior levels by all traditional-age students. Core 100 addresses involvement in learning; Core 200, involvement in personal relationships and Core 300, the responsibilities and rewards of leadership.

This presentation will focus on the elements of the freshman course and their possibilities for ongoing applications. In Core 100, students learn and practice a five-step systematic pattern of thinking in their analyses of selected works. Examples of the effects of the core courses on students, teachers, and potential teachers will be discussed.

9A-6 PEDAGOGY SEMINARS: COMBINING CONTENT AND METHOD FOR FUTURE TEACHERS. Patricia S. Hill and Keith A. Lauderbach, Departments of Chemistry and Industry and Technology, Millersville University, Millersville, PA 17551.

Millersville University has instituted a powerful curriculum experiment which (1) enables future teachers to focus on content from the perspective of a teacher; (2)overcomes institutional barriers by enabling arts and sciences and education faculty to become colleagues in teaching; and (3) provides both faculty members an opportunity to think about, discuss, develop, and improve their own teaching. These courses, called Pedagogy Seminars, are one-credit, team-taught, pass/fail seminars which accompany regular three- or four-credit arts and sciences courses. Faculty teams consist of the "primary course" instructor and a teacher education faculty member. Pedagogy seminars provide an arena for students and the faculty team to think and talk about the integration of content and methods in teaching using the primary course as a case study. An example of a pedagogy seminar in conjunction with a non-science majors chemistry course will be presented.

Transforming the Chemistry Learning Environment, L. Jones, Organizer — ***Wednesday Morning***

13A-1 PUTTING THE HORSE BEFORE DESCARTES. Dr. Stephen Thompson, Department of Chemistry, Colorado State University, Fort Collins, Colorado 80523

The development, acceptance and use of small-scale (microscale) equipment, methods and techniques has solved many of the problems associated with teaching instructional chemistry laboratories. It is now opportune to examine a true integration of lecture and laboratory in which students are much more actively involved in learning chemistry. The design and implementation of an integrated chemistry course for freshman science majors will be discussed together with examples of modules and projects. The reconceptualization of content for this new type of course will be critically examined, especially the role and place of mathematics in teaching chemistry.

13A-2 SMALL SCALE EXPERIMENTS: CHANGING THE DYNAMICS OF THE INSTRUCTIONAL LABORATORY. Christine M. Dolan and Joseph T. Keiser, Department of Chemistry, The Pennsylvania State University, 152 Davey Laboratory, University Park, PA 16802

Our General Chemistry Lab Program has been converted over to a program that is primarily "microscale". This has laid the foundation for many other changes. For example, the ways in which the material and supplies are distributed has been modified so that the majority of the supplies are within an "arms reach" of each student. The speed with which the experiments can be completed has enabled us to cover more chemistry in the same period, and still have time for a post lab discussion period. The user friendly nature of the equipment combined with the speed of the experiments has facilitated some open ended experiments and projects. The details will be presented regarding how these and other changes affect the "dynamics" of the lab environment.

13A-3 **HOOD COLLEGE'S INTEGRATED LECTURE/LAB GENERAL CHEMISTRY** S. W. Smith and K. Henry, Hood College, Frederick, MD 21701

By May, 1994 Hood College, a liberal arts college for women, will have had a year of experience in teaching one section of General Chemistry as an integrated laboratory/lecture course. The goals of this project are to improve student attitude about chemistry and to improve retention of concepts. Honors students in this section have met twice a week for 3 hours/session. Group work, relevance, and "discovery" exercises are important parts of the course. Activities are aimed at giving students experiences upon which to build understanding of concepts in chemistry. Students design and execute small experiments and report their results through exam questions, formal written reports, and poster sessions. Students respond well to this new approach to learning chemistry, and the department is satisfied enough that it has made a commitment to teach all four sections of General Chemistry as integrated lecture/laboratory next fall.

13A-5 **COOPERATIVE LEARNING: AN APPROACH FOR LARGE ENROLLMENT COURSES.** Melanie M. Cooper, Department of Chemistry, Clemson University, Clemson SC 29634.

The large enrollment lecture format is without doubt one of the most efficient and cost effective methods for information delivery. However, few would argue with the proposition that it is probably not the most effective method, particularly from the viewpoint of the student. In such a course format the student is placed in a passive role hardly conducive to learning. Since it is unlikely that the large lecture format will be replaced at many institutions in the near future, it becomes particularly important to search for teaching methods which will counteract the student passivity and place the student in a more active learning environment. One such method involves cooperative learning. Methods for the introduction of cooperative learning techniques into the large lecture format will be discussed

13A-4 PEER INSTRUCTION: SEMI-STRUCTURED, SKILL-BASED STUDY GROUPS. Brian P. Coppola, Janet Kosinski, Department of Chemistry, The University of Michigan, Ann Arbor, Michigan, 48109.

We have begun to actively support the formation of study groups for students in both terms of our *Structure and Reactivity* course. Although purely bottom-up instruction is the ideal, most students seem to lack the proper metaphors and experience to make peer instruction effective. Using our Science Learning Center as a focus for these activities, we created an office and a new TA position to coordinate the effort. At the beginning of the term, we advertized the opportunity to either be a member or leader of a study group, along with some fairly explicit written expectations about participation. Our office was set up to solve all of the logistical problems: match-ups, room and time reservations, and so on. Every week, specific yet open-ended skill-based tasks are posted for all students in these two courses. Like the studio time in an art or writing course, students in the study groups are expected to bring, display and discuss their work. Study group leaders are supported with weekly staff meetings and other resource support. In its first term of operation, about 300 students (20% of the courses) signed up as group participants, while about 80 students volunteered to be group leaders (which were more than we needed, and caused us to double up on leaders for some groups). Our observations about this term will guide our thinking about the program.

13A-6 **IT'S BETTER TOGETHER: TRANSFORMING CHEMISTRY LECTURE HALLS INTO STRUCTURED COOPERATIVE LEARNING ENVIRONMENTS.** Lynn Geiger, Loretta Jones, and Clark Fields, Dept. of Chemistry and Biochemistry, and Idahlynn Karre, Dept. of Speech Communications, University of Northern Colorado, Greeley, CO 80639.

Our growing understanding of the teaching and learning process in higher education has led chemistry faculty members to value student-centered instructional strategies. As we transition to more active learning in the college classroom we are in search of specific, practical, usable strategies to energize our classrooms. The advantages of the interactive learning environments associated with cooperative learning groups are documented by a considerable body of research. However, rarely have these techniques been used in large, multi-tiered lecture halls. Highly structured team learning and assessment opportunities designed for the lecture hall environment have been applied to enhance students' learning skills and problem-solving abilities, to reinforce their content learning, and to build a sense of community in large classes. Specific techniques and student and faculty reactions will be discussed.

Computer Applications in the Classroom & Laboratory — *Wednesday Morning*
G. Sibert, P. Samuel, Organizers

15C-1 INTRODUCING CHEMISTRY WITH HYPERMEDIA, James H. Reeves and Charles R. Ward, Department of Chemistry, University of North Carolina at Wilmington, 601 S. College Rd., Wilmington, NC 28403.

During the 1993 - 1994 academic year, a complete course in introductory chemistry was taught using the presentation authoring software *Toolbook*. In this seminar, examples from the course that illustrate some of the do's and dont's associated with the effective use of hypermedia will be presented with equipment similar to that employed in our classroom.

15C-2 COUPLING LIVE CHEMISTRY DEMONSTRATIONS AND LABORATORY EXPERIMENTS WITH MULTIMEDIA SOFTWARE: GETTING THE CONCEPT ACROSS TO STUDENTS.
T. J. Greenbowe, Department of Chemistry, Iowa State University, Ames, Iowa 50011

We are using multimedia computer software applications to develop interactive multimedia instructional modules on kinetics, gas-phase equilibrium, and acid-base equilibria topics. In the lecture halls we use a Sony Videographic Multisync projector to display the computer images. In our lecture presentations we integrate live chemistry demonstrations and computer animations. Dynamic events such as reverse and forward reactions in equilibrium systems and kinetic processes can be animated using appropriate software. Students are more apt to make the connection between macroscopic events and microscopic events when the live demonstrations and computer animations are coupled. This talk will feature how we use our multimedia software in the classroom coupled with live demonstrations to make clearer to our students the concepts associated with gas-phase equilibrium and with acid-base equilibria, particularly weak acid and weak base concepts. The examples and live demonstrations presented in this talk go over very well with college students. However, members of the audience are cautioned that some of the examples and demonstrations involve "adult themes" and the examples and demos may offend your sense of "good taste". This talk is an example of what you can do in the live lecture presentation mode that can not be done anywhere else.

15C-3 4M:CHEM - A LECTURE ENHANCEMENT TOOL TO PRESENT LINKED MULTIPLE REPRESENTATIONS OF CHEMICAL PHENOMENA. J.W. Russell, Department of Chemistry, Oakland University, Rochester, MI 48309; R. B. Kozma, J. Davis, T. Jones, and N. Marx, School of Education, University of Michigan, Ann Arbor, MI 48109

4M:CHEM, Multimedia and Mental Models in Chemistry, is a software environment designed to help make large chemistry lectures more interactive and stimulating. Interactivity is promoted by allowing choices of experiments, experimental parameters, and viewing perspectives, Both qualitative and quantitative experiments may be selected for each topic. Upon selection of an experiment a control window opens that shows the chemical symbolic representation for the reaction or species. Choices such as heating, cooling, adding species A, etc., can be made with numerical values specified for quantitative experiments. Videos of actual experiments shown in real time or compressed can be compared with molecular level animations and/or dynamic graphs of macroscopic properties such as concentrations. When multiple representations are viewed simultaneously, actions in each are synchronized. From the control window experiments can be paused and restarted at any time permitting snapshot views. Results of use of 4M:CHEM are being presented in a separate session.

15C-4 STOICHIOMETER D. W. Brooks, University of Nebraska, Lincoln, Nebraska 68588-0355

Stoichiometer runs on Macintosh computers under the HyperCard application. This program allows entry of the formulas of common substances individually or from lists. Entire catalogs can be imported. Subsequent selection of substances by clicking from lists permits calculations that: balance chemical equations; perform mass problems including limiting reagents; convert units; "convert" for states of matter; generate recipes for preparing solutions; predict yields and percent theoretical yields; and generate empirical formulas. These calculations have been available via spreadsheets for many years. Stoichiometer provides an easy-to-use interface. The key distinction of Stoichiometer is that, what ever the last operation it performs, it offers the opportunity for tutoring on that specific problem. This tutoring can be traced back in the program to the most fundamental principles involved in the operation. Balancing equations, for example, gives feedback about atom conservation equations and the matrices used to arrive at a solution, but it also includes opportunities to access text about the conservation of atoms.

15C-5 DEVELOPING HYPERTEXT CHEMISTRY APPLICATIONS FOR MOSAIC. B. M. Tissue, Department of Chemistry, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

Hypertext is a collection of information (text, graphics, audio, and/or video) in computer files that provides links between related material. For educational purposes, the main advantage of these links is the ability to rapidly access relevant remedial or advanced material and to illustrate the connections between a given topic and basic principles. I will describe the development of two hypertext applications (tracks) that are designed for use as supplemental study aids in analytical chemistry courses. One track serves as a tutor of the topics covered in sophomore-level quantitative analysis, and the other track is analogous to a reference encyclopedia of instrumental methods. Both tracks include color graphics of the experiments and instrumentation used in the lab portion of the courses. These hypertext applications are viewed with Mosaic, which is a hypertext information browser (versions exist for Windows, Macintosh, and UNIX) that can access documents on the internet and/or locally on a single computer.

15C-6 COMPUTER GRAPHICS VISUALIZATION EXPERIMENTS IN GENERAL AND ORGANIC CHEMISTRY. S. Hoops and C. W. Finley, Jr. Penn State - New Kensington Campus, 3550 Seventh Street Road, New Kensington, PA 15068-1798

Graphics computers which rapidly produce high resolution images have become important tools for practicing chemists, biochemists and materials scientists. These same tools can free the student to discover molecular structures as three dimensional and dynamic. Chemical educators and students can free themselves from the constraints of two dimensional and static representations. We are in the process of implementing the concept that laboratory experiments can be most valuable when students visualize and analyze submicroscopic structures for the same chemicals they manipulate on the macroscopic scale. This project utilizes SGI Indigo workstations in general and organic chemistry experiments. This project is partially funded by the NSF-ILI program.

15C-7 APPLICATIONS OF MACINTOSH SOFTWARE IN GENERAL CHEMISTRY FOR ENGINEERS AND IN PHYSICAL CHEMISTRY. A. L. Smith, Department of Chemistry, Drexel University, Philadelphia, PA 19104

One of the goals of a new integrated curriculum for engineering students at Drexel is an emphasis on the computer as an aid in study and as a professional and intellectual tool. I will review Macintosh software used by the freshmen in this program: spreadsheet templates for stoichiometry and equilibrium calculations, and Molecular Editor for visualizing basic molecular geometries and solid state structure. I will also comment on the use of electronic mail within the class of 300. In the physical chemistry lab, taken by all chemical engineering students within this curriculum, I will show how Analog Connection Workbench software from Strawberry Tree Inc has been used to acquire data in four different experiments, and how the equation solver TK Solver Plus can be used to perform statistical analysis and model calculations relevant to the interpretation of the data.

TA Training: Solutions to Knotty Problems

S. Selfe, B. Barnes, Organizers

Wednesday Morning

27B-1 MY NAME IS ANA, AND I AM A RECOVERED FOREIGN TA. A TWELVE STEPS PROGRAM FOR THE TRAINING OF INTERNATIONAL TEACHING ASSISTANTS. Ana M. Gaillat. Greenfield Community College. 1 College Dr. Greenfield, MA 01301

We will present a program designed by international teaching assistants and with the well being and optimal performance of international teaching assistants in mind. The principal goal of this project is to design a training sequence for newly arrived international students who will be serving as teaching assistants in undergraduate chemistry courses. The process includes first contact, framing of responsibilities and performance optimization. Practical tips as well as general considerations for training, support and evaluation will be discussed.

27B-2 **LEADERSHIP: TA ROLE, STUDENT GOAL** Dorothy S. Barnes Department of Chemistry University of Massachusetts, Box 34510, Amherst, MA 01003-4510

Chemistry teaching assistants are typically assigned to sections, given limited course information and teaching training for their tasks, then sent off to perform as best they can. They are admonished to cope professionally with the Chemistry content of their assignment, and with all other contingencies which occur in their sections. The TAs' undergraduate program equips them to deal with the Chemistry component, but TAs rarely have training in handling the human behavior segment of their task. Disasters often result when unfortunate behaviors are handled badly. A brief exposure to Group Dynamics and Leadership skills would serve TAs well in establishing good patterns of interactions with their students and in providing a positive role model for the students in their group.

Some typical group dynamics will be presented using scenarios tailored to show how leadership skills can be invoked to make typical Chemistry teaching situations more effective and productive.

27B-3 **COOPERATIVE LEARNING AND TEAM TECHNIQUES IN TEACHING ASSISTANT TRAINING.** James P. Birk and Martha J. Kurtz, Department of Chemistry, Arizona State University, Tempe, AZ 85287-1604.

For many years we have held a week-long orientation and training session for new teaching assistants just prior to the start of the semester. This program has involved traditional teaching techniques -- primarily lecture, with some laboratory time and time set aside for discussion. The discussion periods have generally not been very productive due to lack of participation. We wish to report on a modification of this program using cooperative learning techniques, which we have found to be more effective. As a result of the success of this modification, we have also changed the manner in which weekly staff meetings are held. These meetings are now active sessions in which the teaching assistants are formed into teams and in which the teaching assistants have both responsibility for the success of the meetings and control over the content of the meetings. This modification has resulted in improved performance by the teaching assistants.

Nurturing Chemistry Majors at Large Universities, L. Peck, Organizer *Wednesday Morning*

28B-1 A PROBLEM-SOLVING ORGANIC LABORATORY COURSE. Joseph P. Dinnocenzo, Department of Chemistry, University of Rochester, Rochester, New York 14627-0216

There is general agreement among faculty that laboratory instruction is a crucial component of teaching chemistry. The trouble is that our students frequently fail to arrive at the same conclusion based upon their laboratory experiences! Too often, they find the lab neither interesting nor instructive. Why do they not share our enthusiasm for lab work? One possible explanation is that most undergraduate laboratory experiments fail to explicitly recognize that *the goal of experimentation is to solve problems*.

A new organic laboratory course has been developed at the University of Rochester based on this thesis. Experiments in the laboratory program are designed to reveal the nature of chemical problems, to show how they are solved, and, more generally, to teach the process of problem-solving. The experiments build upon and reinforce ideas developed in the lecture. At the same time, they teach the fundamental lab skills and techniques that students are expected to learn in a laboratory course.

28B-2 **BRINGING CHEMISTRY MAJORS INTO THE COMMUNITY.** John P. Lowe, L. Peter Gold, Robert D. Minard, Joseph T. Keiser, Richard A. Henry, Peter C. Jurs, Department of Chemistry, The Pennsylvania State University, University Park, PA 16802.

A number of incremental changes in our program over the past five years have done much to improve the experiences of Penn State's undergraduate Chemistry majors. New programs or facilities that have contributed include a Freshman Seminar, a vigorous summer component for our undergraduate research experience, a Coop program, a Central Instrument Room that greatly increases access to modern equipment for students in several courses, and use of undergraduates as tutors and as lab assistants. The costs and benefits of these and other features of our program will be described.

28B-3 IDENTIFYING AND ATTRACTING POTENTIAL UNDERGRADUATE RESEARCH STUDENTS FROM WITHIN LARGE LECTURE GENERAL CHEMISTRY COURSES‡ Thomas A. Holme, Dept. of Chemistry, University of Wisconsin - Milwaukee, Milwaukee, WI 53201

Methods used to identify student interest in chemistry research during their time in a large lecture, general chemistry course will be discussed. The initial step in the process is the introduction of current research topics during the first two weeks of the course, including a writing assignment about a "hot topic" in chemical or biochemical research. Further interest is fueled by the use of autobiographies of scientists, where student papers are assigned to focus on the nature of scientific research as presented in the reading, as opposed to the factual, scientific content. The ultimate success of this program in attracting students to do research will be noted.

‡Carried out at the Department of Chemistry, University of South Dakota, Vermillion, SD 57069

28B-4 FRESHMAN/SOPHOMORE CHEMISTRY CURRICULUM AUGMENTATION AT DUKE UNIVERSITY. S. W. Baldwin, J. F. Bonk, B. O. Fraser-Reid, and N. A. Porter, P. M. Gross Chemical Laboratory, Duke University, Durham, North Carolina 27708.

Although Duke is not a large university by normal standards, the nature of the undergraduate student body and the composition of the Chemistry faculty combine to create many of the same challenges -- large enrollments in the first two years and the need to make the Chemistry major appealing relatively early. Of the approximately 1600 incoming freshmen each year more than half complete Chemistry 11 & 12, a two-semester introductory course sequence. Of these, nearly 600 go on to take the two semester sophomore-level organic chemistry sequence. An additional 50-60 freshmen with AP scores of 4 and 5 go directly into a separate section of sophomore level organic chemistry.

Curriculum augmentation in the introductory sequence is incorporated by illustrations from "hot" molecules such as taxol; environmental issues are woven into the normal course content. Augmentation in organic chemistry involves a cluster of dedicated MacIntosh computers which are used for molecular modeling, spectroscopy, and laboratory unknowns. A special preceptorial is associated with the group of freshmen enrolled in organic chemistry. In the first semester the preceptorial involves faculty and student presentations; in the second semester it involves formal association with a research group. Freshman and sophomore courses are further enhanced by new computer/video projection systems.

28B-5
THE CHALLENGE OF BEING BOTH LARGE AND PERSONAL, John L. Burmeister, Department of Chemistry and Biochemistry, University of Delaware, Newark, DE 19716

For 13 consecutive years, the University of Delaware has produced one of the 25 largest ACS-certified B.S. chemistry graduating classes in the U.S. Meeting the individual needs of the students in a program this large has involved a number of innovations. Five different undergraduate degree programs are available: BS/Chemistry, BS/Chemistry, with Environmental Chemistry Concentration, BS/Biochemistry, BA/Chemistry, BA/Chemistry Education. The diverse interests and motivations of majors and non-majors are dealt with (and class sizes minimized) by making multiple entry-level classes available: general chemistry (7), analytical chemistry (2), organic chemistry (3), biochemistry (5). Still smaller class sizes (25 max) and considerable enrichment are afforded by honors versions of several of our courses, leading to honors degrees in both chemistry and biochemistry. Undergraduate research is a focal point of the honors program, beginning in the sophomore year. A significant number of scholarships are available for full-time research in the summer for rising juniors. Advising is facilitated by a no-questions-asked, adviser change on demand policy, as well as semester-long freshman orientation and sophomore introduction to research seminars, plus a year-long senior seminar. A Howard Hughes Foundation $1M grant has resulted in the creation of our NUCLEUS program for the recruitment, retention and graduation of under-represented minorities. Our chemistry, biochemistry, and chemical engineering majors, as a group, are always taught in separate courses designed solely for their needs. One of these courses (second semester general chemistry) has been taught via the Personalized System of Instruction (Keller) Method for the past decade. Videotapes of live lectures are available for student's review, as is computer-assisted instruction.

Lasers in the Undergraduate Curriculum, V. Walters, J. de Paula, Organizers *Wednesday Morning*

49A-1 LET LASER LIGHT ILLUMINATE YOUR CHEMISTRY CURRICULUM. Gerald R. Van Hecke, Department of Chemistry, Harvey Mudd College, Claremont, CA 91711.

Lasers are well-established research tools frequently used to detail reaction pathways, elucidate molecular structure, and initiate chemical reactions. Now is an opportune time to use these tools in the undergraduate chemistry curriculum to enhance and enrich student understanding of chemistry concepts and stimulate interest in the subject. Moreover, now is a critical time to provide the student more accurate pictures of the dynamic nature of chemistry with its responsiveness to technological advances. We have introduced laser-dependent experiments from the sophomore to senior years in a variety of laboratory courses. In addition we are designing and developing lecture demonstrations that involve the use of readily available laser light sources. The introduction of laser-dependent experiments and demonstrations does not have to mean large expenditures or having to become a laser expert. What we have in place and what we plan will be discussed.

49A-2 SOME SIMPLE LASER EXPERIMENTS FOR THE GENERAL CHEMISTRY AND QUANTITATIVE ANALYSIS COURSES. Lawrence E. Welch, Daniel M. Mossman, and Robert G. Kooser, Knox College, Galesburg, IL 61401

There are a wide variety of laser experiments available for insertion into junior/senior level chemistry courses. Less attention has been focused on laser use in introductory courses. We are interested in adding some simple laser experiments to our first year chemistry curriculum, in particular ones that focus on chemical information rather than optical principles. Two experiments have been adapted from the chemical literature, and two new experiments have been created. Two of the experiements are used in general chemistry: the heat capacities of a series of solvents are measured by monitoring the degree of thermal lensing of a He-Ne probe beam, and the rate of a reaction is measured by following the refractive index change of the reaction mixture. Two other experiments are taught in the quantitative analysis course: The quantitation of fructose by solution refractometry and the complexometric titration of calcium and magnesium in limestone using photometric detection.

49A-3 AN INTRODUCTORY DYE LASER EXPERIMENT FOR PHYSICAL CHEMISTRY LAB. Sally R. Hair, Department of Chemistry, Allegheny College, Meadville, PA 16335

Students measure the visible absorption spectrum, the fluorescence spectrum, and the dye laser emission curve of one or more laser dyes. The absorption and fluorescence spectra are measured using commercial spectrometers and the laser emission curve is measured with a nitrogen pumped dye laser and an energy meter. While this experiment produces qualitative results, its investigative flavor allows students to figure out for themselves the nature of the energy levels of the dye molecule and how the dye laser works. They must draw on a variety of spectroscopic and kinetic concepts to understand the meaning of the three spectra and the relationship between them. In addition, the students particularly enjoy maximizing the dye laser energy by making adjustment to the optics in the laser cavity. This allows them to "tinker" with the inner workings of an instrument in a more direct way that they have experienced before.

49A-4 LASER PHOTOCHEMISTRY LABORATORY AT POTSDAM COLLEGE. Sean McCarthy, Christopher Smith and Nicholas Zevos, Chemistry Department, Potsdam College (SUNY), Potsdam, NY 13676.

The undergraduate physical chemistry course at Potsdam College has recently been restructured to include experiments that employ lasers. The instrumentation is centered on the Nitrogen/Dye laser system described by dePaula (1). This laser system provides the opportunity for undergraduates to readily conduct fluorescence quenching and multiphoton experiments. The He-Ne laser system described by Polik (1) is employed to introduce the student to the principles of laser operation by observation and experimentation.

The instrumentation has also been employed in undergraduate photochemical research. These investigations include dye sensitized energy/electron transfer reactions and environmental photochemistry. The photolysis of dilute aqueous solutions of aromatic organomercury compounds will be used to describe the steady state and laser experiments that are currently being conducted by undergraduate chemistry students.

(1) Physical Chemistry: Developing a Dynamic Curriculum, R.W. Schwenz and R.J. Moore, editors, American Chemical Society 1993.

53-1 **PROMOTING CRITICAL THINKING IN PHYSICAL CHEMISTRY THROUGH GUIDED INSTRUCTION AND MASTERY LEARNING STRATEGIES.**
Theresa Julia Zielinski, Department of Chemistry, Niagara University, Niagara University, NY 14109.

Physical chemistry, long considered a difficult course because of its abstract nature and dependence on mathematical rigor, gets little attention with respect to pedagogical innovation designed to enhance critical thinking and problem solving skills. This contributes to the observation that majors graduate with weak chemical reasoning skills, inadequate expressive skills, and persistent scientific misconceptions, Traditionally, instruction consists primarily of derivations by the instructor, passive reception by students, and an algorithm problem solving technique that is supported by traditional examination practices that operate at the lower levels of Bloom's taxonomy. In this paper an active learning instructional model that draws on the research on student intellectual development (the Perry Model) and student concept construction is described. The main features include: a) explicit use of goals and objectives for each learning unit; b) guided readings of the text; c) cooperative learning activities during class; and d) mastery learning principles.

53-2 PROMOTING SCIENCE LITERACY: THE ROLE OF MEANINGFUL LEARNING.
Stacey Lowery Bretz, Cornell University, Department of Education, Ithaca, NY 14853.

While no consensus exists on the definition of science literacy, at its core is the idea of a scientific knowledge base which must be applied to the personal dimensions of social, economical, and political situations. Students must be able to utilize this knowledge to make informed decisions; they must be able to recognize when they need more information, to identify credible sources of such information, and to incorporate this new information into their knowledge base. In other words, they must be able to learn meaningfully and to be cognizant of their learning.

Meaningful learning is the process by which new knowledge is substantively incorporated into an individual's existing cognitive structures. Hence, knowledge is viewed as a human construction, and the business of education is to enable people to construct knowledge.

This paper will present conceptualizations of science literacy and meaningful learning as experienced by nonscience majors in an innovative introductory chemistry course designed to teach some principles of organic chemistry to the novice undergraduate through a case-based approach. The implications of these conceptualizations for curriculum development will be discussed.

53-3

PICTURES AND WORDS: DOES ONE YIELD A 10^3 INCREASE IN UNDERSTANDING THE OTHER?
Conrad L. Stanitski, Department of Chemistry, University of Central Arkansas, Conway, AR 72035

Pickering (J Chem Ed 64, 508, 1987) and others have explored relationships between concept learning and problem solving , i.e., does the ability to solve successfully a quantitative problem indicate an understanding of the underlying molecular concepts?

The interpretation of Gas Laws through Kinetic Molecular Theory provides an opportunity to assess the accuracy of student concept learning in terms of molecular level events. This talk will present data obtained from among a series of introductory chemistry courses to questions using schematic illustration of gaseous phenomena. Student audiences for the study varied widely: general chemistry classes for science majors; chemistry classes for allied-health students; and students with no prior chemistry background taking a preparatory chemistry course for entry into either the general or allied-health chemistry course sequences. The data will be discussed in terms of performance differences and similarities among the groups, and reasons for them.

53-4 PREDICTING AND DIAGNOSING SUCCESS IN INTRODUCTORY CHEMISTRY USING BACKGROUND, ACADEMIC, AND PSYCHOLOGICAL CRITERIA.
Brian P. Coppola, Oksana Malanchuk, Paul Pintrich, Shirley Yu, Department of Chemistry, The Center for Research on Learning and Teaching, and the School of Education, The University of Michigan, Ann Arbor, Michigan, 48109.

For two consecutive fall terms, we have administered a modified version of the Motivated Strategies for Learning Questionnaire (MSLQ) as a pre- and post-test to 3000 students in the two different first term chemistry courses at the University of Michigan. We are interested in questions of the predictive and diagnostic values of both academic and psychological student attributes on course performance as a way to guide placement advice and instructional design. A hierarchical regression analysis using background demographics, background achievement, motivation issues and learning strategy use against course performance was performed. Although background achievement, especially the math SAT score, was a significant predictor, background demographics such as gender and ethnicity were not. Interestingly, the psychological attributes were as significant, in many cases, as the background data, especially in the non-traditional *Structure and Reactivity* course. Results for the different chemistry courses were also compared.

53-5 USING EXAMINATIONS FOR IDENTIFYING "HOCS" AND "LOCS STUDENTS" IN SCIENCE TEACHING; THE CHEMISTRY CONNECTION,
Uri Zoller[1] and Georgius Tsaparlis[2], [1]Haifa University, Oranim, Israel, [2]University of Ioannina, Greece

A major driving force in the current effort to reform science education is the conviction of many that it is vital for our students to develop their higher-order cognitive skills (HOCS) capacity in order to effectively function in our modern, complex science and technology-based society. In-line with this rationale this study focuses on the use of examinations for both identification of "HOCS" - and "LOCS students" and evaluation of chemistry (and science) courses in terms of their students' progress in HOCS. Remediation teaching strategies, including examinations can then be designed and implemented accordingly. This usage of examinations is explored and demonstrated via 'post factum' data analysis of two different case studies: The General Examination (in chemistry) and the panhellenic Chemistry Competition administered nationally in Greece for secondary school graduates in 1991 (N=1352), and a first mid-term, 'take-home/make your choice' exam in a freshman general chemistry course administered to a class of biology majors (N=22) in Israel. The main findings are that (a) examinations, particularly those containing both HOCS and LOCS questions, can be effectively used to identify "HOCS" and "LOCS-students"; (b) there is no correlation between students' "HOCS" and "LOCS performance"; and (c) given a free choice, "LOCS questions" are preferred to "HOCS questions" by students apparently due to their governing "student proof" attitude towards examinations. Based on the above and previous related studies the fostering of HOCS and conceptual learning is advocated: It *can* and *should* be done.

53-6 THE DEVELOPMENT OF HIGHER ORDER THINKING SKILLS IN ORGANIC CHEMISTRY: ONE INSTRUCTOR'S TEACHING AND EVALUATION METHODS.
Richard C. Bauer, George M. Bodner, and Kirsten A. Lowrey, Department of Chemistry, and G. Marc Loudon, Department of Pharmacy and Pharmacological Sciences, Purdue University, West Lafayette, IN 47907.

The traditional mode of delivery in college chemistry courses has been the lecture. One of the arguments leveled against the lecture modality is its inability to foster the development of students' higher order thinking processes during class meetings. Even if students are attentive in class, they spend their time listening to the instructor cover material at knowledge or comprehension levels. Elsewhere, the authors describe the discussion format that an organic chemistry instructor used to foster students' higher order thinking processes during class sessions. In this paper the authors describe the evidence that shows that this mode of delivery fosters the improvement of higher order thinking skills by examining the testing strategy and test questions used to evaluate the students.

S3-7 THE ROLE OF REPRESENTATION SYSTEMS IN PROBLEM SOLVING IN CHEMISTRY, George M. Bodner and Daniel S. Domin, Purdue University

The results of a series of experiments on problem solving in chemistry will be discussed in terms of their implications for the role that representations and multiple representational systems play in determining the success or failure of students working on such tasks. Particular attention will be paid to the representational systems that students use, the difficulties that arise when inappropriate representational systems are used, differences between the internal representations that students and their instructors build from the same external representations, and the power of multiple representation systems for problem solving.

Innovative Teacher Education Programs, P. Hill, Organizer *Wednesday Afternoon*

9B-1 TEACHING SCIENCE WITH TOYS — A HANDS-ON WORKSHOP FOR K-12 TEACHERS, J. L. Sarquis, Chemistry Department, Miami University, Oxford, OH 45056, A. M. Sarquis, Chemistry Department, Miami University-Middletown, Middletown, OH 45042, and J. P. Williams, Chemistry Department, Miami University-Hamilton, Hamilton, OH 45011.

"Teaching Science With TOYS" is a graduate-credit teacher in-service workshop designed to show K-12 teachers how toys car be used in science instruction. Our workshop formats include once-a-month Friday-Saturday meetings on campus during the academic year and a 3-week residential course during the summer. The workshops have included from 48 to 72 teachers subdivided into grade-level groups of 16-22. The participants are generally part of a team of several teachers from different grades within a district. The workshop is team-taught by chemistry and physics faculty at Miami University. The instructional team also includes peer teachers who have been participants in previous TOYS workshops. Workshop mechanics, materials, and evaluation will be presented. Funding has been provided by the National Science Foundation, the Ohio Board of Regents, Miami University, and the Cincinnati Section ACS.

9B-2 TEACHING WITH HANDS-ON SCIENCE ACTIVITIES IN ELEMENTARY SCHOOLS, Charles Scaife, Department of Chemistry, Union College, Schenectady, NY 12308

The primary purposes of this project were to demonstrate the use of hands-on science activities to administrators, teachers, and parents of elementary students and to increase the level of confidence in the use of these activities by teachers and parents. This will enable these teachers and parents, both in school and in the home, to (1) generate increased interest and passion for science in elementary students, (2) introduce more science content and scientific thinking to elementary students, and (3) provide enthusiastic daily encouragement and support for further study of science by elementary students.

Efforts involved (1) demonstration workshops presenting hands-on science activities that teachers can use in their classrooms, (2) workshops in which teachers demonstrated hands-on science activities to each other, (3) classroom presentations by me and by teachers under my guidance of hands-on science activities with students, (4) evening or Saturday workshops for parents and children involving science activities that can be done in the home, and (5) workshops for teachers and parents discussing sources of both equipment and curricular materials. Results of these efforts will be summarized.

9B-3 MILLSAPS COLLEGE'S MASTER TEACHING PROGRAM IN CHEMISTRY AND BIOLOGY: HAVE MODULES - WILL TRAIN PRE-COLLEGE TEACHERS.

Johnnie-Marie Whitfield, Chemistry Department, Millsaps College, Jackson, Mississippi 39210.

Funded by a grant from the Booth Ferris Foundation, the Millsaps Master Teacher Program (MTP) has developed and field tested over fifteen experimental modules suitable for use in high school chemistry and biology as well as middle school science courses. Teachers participate in hands-on sessions and work through the various modules. In the summer, high school students are available on campus in a coordinated program so the teachers are able to quickly implement the modules with students. Additional workshops are scheduled in the academic year. Kits with most of the necessary supplies for each module have been designed and prepackaged for easy set-up, use, and low-cost duplication and refill. The MTP Director is available when invited for follow-up visits with the teachers in their school classes and laboratories.

9B-4 *CHEMSOURCE:* A SUPPORT STRATEGY FOR TEACHERS OF INTRODUCTORY CHEMISTRY COURSES

Mary Virginia Orna, College of New Rochelle, New Rochelle, NY; James O. Schreck, University of Northern Colorado, Greeley, CO; Dorothy Gabel, Indiana University, Bloomington, IN

ChemSource is an array of linked products designed to provide innovative experiences and effective strategies for preservice and inservice teachers of chemistry that will improve their effectiveness as teachers. It consists of two major parts, *SourceBook* and *SourceView*. It is designed to be an integrated resource for teachers which utilizes and anticipates developments in high-technology communication in education. *SourceBook* contains resources in over thirty curricular topics accompanied by general practical methodologies and collected practical information in both hard copy and electronic format interfaced with a comprehensive planning toolkit. *SourceView*, the second component, consists of five hours of videotapes (accompanied by a user's guide) providing examples of specific and generic teaching skills for a variety of classroom settings.

9B-5 PARTNERS FOR TERRIFIC SCIENCE, A. M. Sarquis, Center for Chemical Education, Miami University Middletown, Middletown, OH 45042.

Partners is a multifaceted effort to provide teachers with a behind-the-scenes look at the role chemistry plays in the development and manufacture of items we use everyday. Chemistry, which is at the heart of the research, development, manufacture, and regulatory compliance efforts, provides the content orientation of these teacher enhancement programs. Social, economic, environmental, and governmental issues are also addressed through the Industrial Applications of Chemistry course, Industrial Internship Program, Partners Facilitators and Affiliates Networks, and the companion Student Programs. These initiatives are supported through an industrial/academic partnership including over 50 private sector-partners and the Ohio Chemical Council and its 100+ members. Additionally, grants have been provided from the NSF, the US Department of Education, and the ACS-Cincinnati Section.

This presentation will review the innovative aspects of the Partners efforts and outline the elements which have been identified as leading to its success. Several of the Partners activities will also be shared.

9B-6 TEACHEM: AN ORGANIZATION DEDICATED TO IMPROVING HOW HIGH SCHOOL AND COLLEGE FACULTY TEACH CHEM. Albert H. Martin, Department of Chemistry, Moravian College Bethlehem, PA 18018, and Roy Arlotto, L.E. Dieruff High School, Allentown, PA

"Just what do college teachers expect high school students to learn in chemistry?" Trying to answer this question led to the 1982 founding of TEACHEM an organization of high school and college teachers in the Lehigh Valley. Through funding from the Lehigh Valley Section of the American Chemical Society, this group holds monthly meetings and yearly workshops to improve the chemical education in the Lehigh Valley. This presentation will include a discussion of how the group was started, its means of operation, a review of some of the programs and workshops held, and suggestions for other groups of teachers interested in forming a similar organization.

Conversation: What is the Role of AP Chemistry in the Third Millennium? ***Wednesday Afternoon***
A. Arnold, Organizer

10-1 TEACHING AP CHEMISTRY FOR THE FIRST TIME. Anne-Marie Arnold, North Middlesex Regional High School, 19 Main Street, Townsend, MA 01469

I will try to address the problems of starting up an AP course and coping with the following:

- no extra prep time
- limited equipment and chemicals
- teaching kinetics to students who have limited knowledge of calculus and logarithms
- no one to help solve difficult problems
- access to teacher AP courses

10-2 BUILDING ON THE AP EXPERIENCE. Patricia Lyons Samuel, Department of Chemistry, Boston University, Boston, MA 02215

For a student who has successfully completed AP chemistry and is a college/university fresher, the logical question is, "What's next?" Placing the student in organic chemistry, if it is a sophomore course, is undesirable, but so is sitting out chemistry for a year until the student matures. A solution that we have found to be workable is an honors-level general and quantitative analysis course designed for students with a strong high school background. AP chemistry is not a requirement for this course. For students who take the mainstream science majors' general chemistry course and have a strong interest in chemistry there exists a crossover path via the second semester honors-level laboratory, quantitative analysis.

10-3 HOW "ADVANCED" IS ADVANCED PLACEMENT CHEMISTRY? Wallace J. Gleekman, Brookline High School, Brookline, Massachusetts 02146

Is advanced placement chemistry really advanced? what is right about it? What is wrong? Are we marching to the tune of a different drummer? Because a student takes two years of chemistry or even three, does this mean it is really "advanced"? Can we do the same thing in only one year? Does the nitty gritty of it all boil down to the type of student that takes the course? Are there courses at the college level that can be taught in high school? And is this what we mean when we say A.P. Chemistry? Lively discussion will follow.

10-4 A DISCUSSION OF ADVANCED PLACEMENT CHEMISTRY, Nicholas Kildahl, Department of Chemistry, Worcester Polytechnic Institute, Worcester, MA 01609.

Advanced Placement Chemistry will be discussed from the viewpoint of the university educator. The appropriateness of teaching certain concepts at the high school level will be addressed from the standpoint of student readiness. The impact of the high school program on the effectiveness and appeal of the college course will be discussed.

10-5 AP CHEMISTRY ON AN INDEPENDENT STUDY BASIS. Mike Readnour, Chemistry Department, Southeast Missouri State University, Cape Girardeau, MO 63701

There are a number of difficulties teachers face in teaching Advanced Placement Chemistry. One of those difficulties is finding time to cover all of the topics in class, and do all of the laboratory experiments needed to prepare the students to take the AP exam. A problem that teachers at small schools have is trying to find enough qualified students to justify teaching the course. Self contained units on topics in chemistry (such as kinetics, equilibrium, coordination chemistry and nuclear chemistry), along with laboratory experiments and problem sets have been prepared. Teachers can give these units to students to work on outside of class on their own in order to help prepare them for the AP exam. Teachers in schools that are not large enough to have an AP Chemistry class may have one or more students that would like to prepare themselves to take the AP Chemistry exam. They could study units of material on the topics in the course under the teacher's supervision on a independent or individualized study basis.

12-1 WHAT CHEMISTRY SHOULD ENGINEERING STUDENTS STUDY?
Michael J. Pavelich and Thomas R. Wildeman, Department of Chemistry and Geochemistry, Colorado School of Mines, Golden, CO 80401.

This question is a recurring part of our curriculum planning since over 90% of the students in our general and physical chemistry classes are engineering majors. Our answer is primarily on a philosophical level. (1) They need to develop effective mental models of matter at the molecular/atomic level. As they make decisions on strengths of materials, light absorption, hazardous waste transport in the environment, they need effective mental pictures of what that matter is doing. (2) They must be practiced in the quantitative arguments of chemistry. Their professions are strongly quantitative, thus they will often need to deal with chemistry knowledge that way. These two precepts dictate the flavor of our courses (quantitative, inquiry) and the subjects emphasized (stoichiometry and solution equilibria). We ignore bonding theories and biochemistry. These decisions will be presented to the audience for debate and critique.

12-2 CHEMISTRY COURSES FOR ENGINEERS AT PURDUE UNIVERSITY.
Dor Ben-Amotz, George M. Bodner, Department of Chemistry, Purdue University, West Lafayette, IN 47907-1393

Of the 4200 freshman chemistry students attending Purdue each year, 1800 plan to major in engineering disciplines. In order to accomodate the special needs of some of these students a two semester freshman chemistry course is offered. This course is decoupled from the associated laboratory course and emphasizes applications such as corrosion, metal alloy phase diagrams, ceramics, glasses and polymers. Higher level courses catering predominantly to chemical engineers include one semester physical chemistry lecture and laboratory courses (~100 students per semester). The lecture course covers transport phenomena, quantum chemistry, spectroscopy, and electrochemistry, but contains less thermodynamics than the standard sequence. The laboratory course features computer interfacing and a format in which the 12 students in each section work in pairs on one of 6 duplicate instruments. Thus the entire class performs the same experiment each week, greatly improving the cohesiveness and popularity of this course.

Transforming the Chemistry Learning Environment, L. Jones, Organizer *Wednesday Afternoon*

13B-1 USING CALCULATED ATOMIC AND MOLECULAR IMAGES IN THE HIGH SCHOOL CHEMISTRY CLASSROOM, Barry E. Rowe, NCSA ChemViz Group, University of Illinois, Champaign, IL 61820

During the last few years, the cost of computers, presentation equipment and software has declined as the power and speed of desk top computers has increased. These changes have allowed the Chemistry teacher to use advanced technology to present more sophisticated models of atomic and molecular structure that prepare all high school students for a better understanding of nature. The trend towards more visual models of abstract concepts such as the Quantum Mechanical model can only accelerate as more and more students are exposed to visualization in the classroom. This presentation will demonstrate methods of presenting images, appropriate images to use,and how to use these images to engage all Chemistry students in atomic and molecular modeling

13B-2 INTEGRATING NEW TECHNIQUES WITH TRADITIONAL METHODS IN THE GENERAL CHEMISTRY LECTURE. Harry E. Pence, Department of Chemistry, SUNY Oneonta, Oneonta, NY 13820

This paper describes an effort to combine a simple multimedia system and cooperative learning with traditional lecture methods to create a coherent, effective educational approach to general chemistry instruction. Video tapes and laserdiscs are blended with live demonstrations to emphasize the visual aspect of chemistry; lecture partners, a cooperative learning approach, encourages active student participation and improves the students' observational skills; traditional lecture techniques provide the structure that many students still find to be helpful. Integrating these techniques can enhance both student involvement and performance.

13B-3 COMPUTER SUPPORT FOR INTERACTIVE LECTURES
Dr. John S. Martin, Department of Chemistry, The University of Alberta, Edmonton, Alberta Canada T6G 2G2 FAX (403) 492-8231

With suitable projected simulations and animations you can make your lectures spontaneous and interactive. Smart Instructor's Resources (SIRs) contain a wealth of chemical information, available at the touch of a mouse button. I shall demonstrate how they let me make Nature guide students' learning. Instead of telling them what the chemicals do, I let the class (with suitable guidance) ask "What do you think would happen if...?" and get an immediate answer on the screen.

These SIRs have intuitive interfaces, so you can think chemistry, not computing. They impose no particular pedagogy, and you can switch your approach to a topic in mid-lecture in response to the needs and interests of the class. They cover most of the areas of introductory Chemistry, and run on PC (DOS) computers with projection facilities.

13B-4 NEW APPROACHES IN GENERAL AND INORGANIC CHEMISTRY John C. Kotz, Chemistry Department, State University of New York, Oneonta, NY 13820

We have been experimenting with some new approaches to teaching general and inorganic chemistry. For example, the lecture notes in General Chemistry are now displayed in the lecture room using a Macintosh computer. Among the advantages of this technique are the following: (a) It allows us easily to incorporate interactive molecular models and simulations, (b) it gives us a readily available library of information, and (c) students can review the notes later in our computer center. Second, we have been using molecular modeling software as an integral part of inorganic chemistry lecture and laboratory courses. Modeling is an increasingly important aspect of modern chemistry, and we find that students have a greater appreciation of structure if they construct their own models using the latest computer software.

13B-5 **CHEMISTRY 101 MULTIMEDIA: INTERACTIVE LEARNING TOOLS FOR THE MTV GENERATION.** I. K. Stovall and R. B. Wilson, Dept. of Chemistry, University of Illinois, 601 S. Mathews, Urbana, IL 61801

IMAGES. In our society, video images are used to sell everything from sneakers to securities. We must use images and multimedia technology to sell chemistry to our customers, the students. In fact, multimedia is more than a marketing gimmick. This technology enables visualization of chemical phenomena by bringing video, digital images and animation to the fingertips of students and teachers. We are developing a series of multimedia lessons to aid instructors in the classroom and students outside of class. As a presentation tool, the lessons help teachers define terms, explain and visualize abstract ideas and solve problems. Outside the classroom, students can use the lessons for many of the same reasons they use a textbook. Multimedia computer lessons may be a more effective learning tool than textbooks, because computers are by nature interactive. Details about implementation, topical coverage, mechanics and evaluation will be discussed.

13B-6 **INTRODUCTORY COLLEGE CHEMISTRY COURSES PRESENTED BY "DISTANCE-LEARNING" METHODOLOGY,** **Robert H. Paine, Gerald A. Takacs, Department of Chemistry, Rochester Institute of Technology, Rochester, New York 14623.**

The Department of Chemistry at (RIT) over the past two years has prepared and presented Chemistry courses for students at remote sites. The first endeavor, a two-course "distance-learning" sequence for students in Michigan (General Motors), was Introductory Chemistry: Chemical Principles I & II, which included lectures on video-tapes, participating weekly recitations via electronic blackboard and telephone, and well-integrated laboratory classes in Michigan. These courses were taught concurrently on the RIT campus during the day hours for full-time students and evening for part-time students. Following the success of this program, a second two-course distance-learning sequence was prepared for students at 4 community colleges in western New York. Introductory Basic Chemistry I & II, (essentially Chemistry of Materials) was prepared and taught in a fashion similar to that described previously. The implementation and success of the distance-learning presentations are described. Types of presentation styles and ancillary materials for each of the different courses are discussed. A detailed comparison of the students performances in each of these classes is included. Difficulties in starting an innovative program such as this, as well as plans for future distancelearning courses are presented.

15D-1 LABVIEW DATA ACQUISITION AND DATA ANALYSIS ROUTINES: A TOOL FOR THE REVITALIZATION OF GENERAL AND PHYSICAL CHEMISTRY LABS. James R. Hutchison, Dept. of Chemistry, Alma College, Alma, MI 48801

Macintosh computers, running data acquisition and data analysis routines written in the LabVIEW programming language, have been used to revitalize our General Chemistry and Physical Chemistry laboratories. An interface to a temperature probe is used for sophisticated experiments in calorimetry, freezing point depression and the construction of solid-liquid phase diagrams. An interface to a pH meter and a computer controlled buret is used to study the titration curves of weak acids and bases. An interface to a low-cost, single-beam, visible spectrophotometer creates a scanning spectrophotometer which is used for a variety of experiments: the study the nature of visible spectra, spectroscopic quantitative analysis, and the study of reaction kinetics. These acquisition and analysis routines will be demonstrated and discussed.

15D-2 COMPUTER-INTERFACED EXPERIMENTATION IN A LABORATORY-CENTERED CURRICULUM. Nancy Devino and Cindy Samet, Dept. of Chemistry, Dickinson College, Carlisle, PA, 17013-2986.

Dickinson College introduced a laboratory-centered chemistry curriculum in Fall, 1993. The first course in the sequence, BenchChem, is taught in a workshop format with three 2-hour class periods per week. BenchChem is taught using the discovery approach in which students deduce fundamental chemical concepts from experimental results. Macintosh computers are used heavily in this course in order to emphasize the interpretation of results rather than the acquisition of data. Several experiments used in BenchChem will be demonstrated with the Vernier Software Universal Lab Interface and accompanying data collection probes. One such experiment is a study of the stoichiometry and kinetics of the reaction between magnesium and HCl, in which a barometer probe will be used to measure H_2 pressure as a function of time. In a second experiment, barometer and temperature probes will be used to study the vapor pressure of organic liquids as a function of temperature. Finally, a filter colorimeter will be used in experiments designed to teach basic principles of spectrophotometry, to construct Beer's Law plots, and to investigate the kinetic behavior of reactions that yield or consume colored products. Additional results will be presented, together with experimental details and student lab directions. Applications of this equipment in advanced courses will also be described.

15D-3 A COMPUTER-BASED LABORATORY CURRICULUM FOR GENERAL CHEMISTRY. John C. Hansen, Minnesota State University - Akita, Akita, Japan (on leave from Southwest State University, Marshall, MN, USA)

A proposed curriculum for general chemistry laboratory in which microcomputers are incorporated is described. At the beginning of the year, spreadsheets and graphing software as tools for data analysis are introduced. Later, a series of experiments is begun in which computers are used for data acquisition. They are interspersed with traditional experiments and spread throughout the entire year. Macintosh computers along with the ULI boards from Vernier Software are used in the laboratory. Some of the applications also make use of the LabVIEW interfacing system from National Instruments. Computer-based experiments include gas-law, calorimetry, and kinetics experiments in addition to pH titration and spectrophotometry. An overview of the proposed curriculum is given along with a brief description each computer-based experiment. Selected experiments are described in greater detail.

15D-4 USE OF IBM PERSONAL SCIENCE LABORATORY (PSL) AND MICROSOFT WINDOWS AND EXCEL IN GENERAL CHEMISTRY LABORATORY. John R. Zimmer, James Reeves, Charles Ward, Department of Chemistry, UNCW, Wilmington, NC 28403

As part of an effort to improve General Chemistry, a series of labs were developed using IBM PSL, Microsoft Windows and Excel. Experiments were designed to effectively use the rapid response and accuracy of the IBM PSL and the graphing capability of Excel. Students were expected to correlate and interpret experimental results. The paper will explain the laboratory setup, the presentation of discovery labs, how students were exposed to increasingly difficult computer challenges, and how students reacted to them.

15D-5 COMPUTERS IN CHEMISTRY LABORATORY INSTRUCTION THE CCLI INITIATIVE. Susan Arena, University of Illinois, Department of Chemistry, Box A-2, 601 S. Mathews, Urbana, IL. 61801

Integration of the personal computer into the instructional laboratory can enhance experiment design, data acquisition and data analysis in the laboratory in much the same way as the wordprocessor has enhanced writing. The CCLI Initiative is an NSF-funded consortium of eight colleges and universities involved in the development of computer-integrated curricula. The Lab-Works program is now in use in more than 90 colleges and universities. This paper will present the educational philosophy upon which this work is based, and demonstrate the use of the interface unit and software for design, data acquisition and data analysis. A sample curriculum guide containing experiments and instructor resources will be available to view.

15D-6 COMPUTERS IN CHEMISTRY LABORATORY INSTRUCTION THE CCLI INITIATIVE. Dale Hammond, Brigham Young University-Hawaii, Laie, HI 96762

Integration of MAC the personal computer into the instructional laboratory can enhance experiment design, data acquisition and data analysis in the laboratory in much the same way as the wordprocessor has enhanced writing. The CCLI Initiative is an NSF-funded consortium of eight colleges and universities involved in the development of computer-integrated curricula. The Lab-Works program is now in use in more than 90 colleges and universities. This paper will present the educational philosophy upon which this work is based, and demonstrate the use of the interface unit and software for design, data acquisition and data analysis. Samples of a curriculum guide containing a library of experiments and instructor resources.

15D-7 **IMPLEMENTING A DIGITAL-VOLTMETER GENERAL CHEMISTRY LAB COMPUTER INTERFACE.** H. Bradford Thompson and Ingrid Morken, Department of Chemistry, Gustavus Adolphus College, Saint Peter, MN 56082

An auto-ranging digital voltmeter with a serial port output constitutes an affordable, versatile computer interface for the general chemistry lab. The DVM has the advantage that the user can see what is being measured, lessening the black-box aspect of interfaced experiments. We will describe the Gustavus Adolphus implementation, including a versatile interrupt-driven data-collection system. Use in typical lab experiments will be discussed.

19-1 **COMPUTER-GENERATED POURBAIX DIAGRAMS AND DESCRIPTIVE INORGANIC CHEMISTRY.**

James P. Birk and Laura L. Tayer, Department of Chemistry, Arizona State University, Tempe, AZ 85287-1604.

An expert system-based computer program is being developed to draw and interpret Pourbaix diagrams interactively. The program will have the capacity to draw diagrams for all the elements under both standard and non-standard concentrations. Overlays of two diagrams can be used to identify areas of EH and pH in which given species will co-exist or will react with one another. Unlike other diagrams (Frost diagrams and Latimer diagrams) that can be used to represent redox reactions, Pourbaix diagrams take into account both redox and hydrolysis reactions. Examples will be given to show how Pourbaix diagrams can be used in discussions of aqueous environmental chemistry and to predict chemical reactivity under various conditions. The utility of this program as an educational tool will be discussed.

19-2 A CRYSTAL BUILDING AND VIEWING PROGRAM FOR USE WITH HYPERCHEM™.

Arlen Viste, Department of Chemistry, Augustana College, Sioux Falls, SD 57197 and Wayne P. Anderson, Department of Chemistry, Bloomsburg University, Bloomsburg, PA 17815.

A Crystal utility program (XTLW) has been written which facilitates working with crystals in the molecular modeling program HyperChem™ for Windows. XTLW takes crystal structure data as input, produces a standard protein database (.ent) file, and controls HyperChem through DDE (Dynamic Data Exchange) for crystal viewing. XTLW user choices include number of unit cells, hkl planes as surfaces, and connectivities. XTLW serves as a flexible alternative to the Crystal Builder provided in the ChemPlus™ package of HyperChem™ extensions. XTLW includes standard examples of inorganic crystal structures, and facilitates entry of additional structures from the literature. Uses of the XTLW program in inorganic chemistry courses will be discussed. (This work is associated with the MoleCVUE Consortium. HyperChem™ and ChemPlus™ are products of Hypercube, Waterloo Ontario.)

19-3 COMPILED SPREADSHEETS.

Larry H. Wier, Dept of Chemistry, St Bonaventure University, St Bonaventure, N.Y. 14778

Spreadsheet templates are a powerful tool, widely used in Chemistry courses today. Developing such templates is a good compromise between two extremes: coding your own programs from scratch or buying commercial programs. However, templates do suffer from one drawback: they require the spreadsheet program to run. This drawback can be overcome by the use of a spreadsheet compiler, which takes the template and compiles it into a set of standalone executable files. This approach is especially useful when the intended users are spreadsheet neophytes, when templates must be "transportable", or when the integrity of formulas is important. Compiled spreadsheets that calculate percent ionic character in a single bond, dipole moments in diatomic molecules, and nuclear binding energy will be discussed.

19-4 A LIGAND FIELD PROGRAM FOR USE IN INORGANIC CHEMISTRY COURSES, Wayne P. Anderson, Department of Chemistry, Bloomsburg University, Bloomsburg, PA 17815.

A computer program for use in the Windows environment has been developed for calculating the relative energies of the metal d orbitals in transition metal complexes having common geometries. Either a crystal field model or an angular overlap model can be used for the calculations. Crystal field, angular overlap and Racah parameters are included for several metal ion and ligand combinations. In addition, user-supplied parameters may be employed, and donor atom coordinates may be specified for arbitrary geometries. The spin state of the metal ion in the complex is determined automatically from the specified parameters. Energies of d-d transitions for octahedral complexes are also computed. A visual interface is used for input, and results are shown in graphical form. Use of the program in an advanced inorganic chemistry course will be described.

19-5 METHODS FOR INCORPORATING THE CHEMISTRY OF THE ELEMENTS INTO AN INTRODUCTORY INORGANIC LABORATORY. John C. Woolcock, Department of Chemistry, Indiana University of PA, Indiana, PA 15705

While there has been an increased emphasis on incorporating the chemistry of the elements into the inorganic curriculum, less attention has been placed on the how the reactions of the elements and their compounds should be incorporated into a laboratory program. In an attempt to create a sequence of experiments that will introduce students to a wider range of inorganic reactions, we have begun to create laboratory exercises that contain the following features: 1) Focus on the properties one group, or related groups of elements in the periodic table. 2) Use qualitative observations and quantitative data for the reactions of the elements and their compounds to help the students discover important periodic or inorganic principles. 3) Use microscale techniques that provide convenient procedures for comparisons of the elements and compounds. 4) Integrate the Periodic Table Videodisk into the learning cycle. 5) Build on introductory lab skills without overly emphasizing synthetic techniques or qualitative ion analysis. Examples of lab exercises that incorporate these ideas will be presented.

19-6 CURRICULUM MODIFICATIONS TO INCLUDE MORE INORGANIC CHEMISTRY. Joanne A. Smieja, Department of Chemistry, Gonzaga University, Spokane, WA 99258.

Three years ago we implemented a significant modification of the traditional curriculum for science majors. Our goals were threefold: (1) to make the early courses less quantitative and more interesting to a broader student population; (2) to better relate the course material to what chemists actually do; and (3) to prepare students for independent research. The plan which emerged included starting organic chemistry in the freshman year, incorporating a new descriptive inorganic chemistry course in the sophomore year and, for chemistry majors, replacing the upper division discipline specific laboratories with a unified laboratory sequence. This paper will describe our new curriculum and its increased emphasis on inorganic chemistry.

19-7 TEACHING LESS, LEARNING MORE, David C. Finster, Department of Chemistry, Wittenberg University, Springfield, OH 45501

Inorganic chemistry, like all other areas, seems to perpetually suffer from a perceived need to teach more material ("everything is important!") than can be stuffed into the quarter(s) or semester(s) allocated to it. Thus, we rush through material and inevitably reduce some, perhaps much, learning to rote memorization rather than more thoughtful and lasting understanding which we presumably desire. ACS standardized exams and thick textbooks further promote the image that there's much to learn. I contend that two fundamental changes must occur to redress this situation: 1) we must choose to teach less so that students can learn more, and 2) we must change the way we teach in order to force students to change the way they learn. Each of these features will be discussed in this presentation with emphasis on the second one.

New Methods for Laboratory Teaching, M. Cooper, Organizer *Wednesday Afternoon*

29A-1 INQUIRY IN INTRODUCTORY LABS: WHY, WHAT, AND HOW.
Nancy Konigsberg Kerner, Dept. of Chem., The Univ. of Michigan, 3541 chem, Ann Arbor, MI 48109.

Research in the literature reveals a dismal picture of what students learn, or do not learn, about the process of science and chemistry in the traditional laboratory setting. Laboratories are typically described as "noisy" places that are nonconducive to learning. Research in cognitive psychology is discovering that students must become actively engaged in the process of discovering whatever they are learning. The inquiry (also called discovery) lab format is appropriate for active engagement of students. A successful design will give students some opportunity for planning and decision making. The lab will encourage the student to think about what he or she is doing before completing the exercise. During this presentation I will highlight the basic tenets of learning via inquiry and share effective and non-effective strategies. I will present examples based on my experiences as coordinator of the general chem lab program and share data indicating that students can learn in lab. Hopefully, my examples will allow others to circumvent recreating old wheels that don't work.

29A-2 COOPERATIVE CHEMISTRY LABORATORIES. Melanie M. Cooper, Department of Chemistry, Clemson University, Clemson, SC 29634

Most traditional chemistry labs tend to reinforce many student's preconception that science is simply a body of information to be memorized, and that obtaining the "right" answer is the most important aspect of the lab. We have developed a viable plan, for our large enrollment (1,500 students) general chemistry courses, which attempts to overcome the deficiencies in the laboratory experience and supply the structure and support so necessary to students in their early stages of intellectual development. Our students forgo a semester of twelve, individually performed, traditional one period exercises, to work in groups on several research oriented projects per semester. Instead of learning a technique as an end in itself, techniques are learned as a means to an end. Over the course of the semester, students apply their problem solving skills to projects approximating the research process as closely as possible. The students also use both their written and oral communication skills to plan, critique, and evaluate their experiments. Students obtain information on laboratory techniques and their applications by accessing a HyperCard stack that uses audio and video clips to complement written and conventionally illustrated materials. This program, SuperChemLab, also guides students through some of the thought processes and procedures required to devise their own experiments.

29A-3 CHANGING FROM A DIRECTIVE APPROACH TO AN EXPLORATORY APPROACH IN THE GENERAL CHEMISTRY LABORATORY: HELPING STUDENTS THINK ABOUT CHEMISTRY. T. J. Greenbowe and S. A. Heideman, Department of Chemistry, Iowa State University, Ames, Iowa 50011

Many students experience difficulty making the connection between topics taught in the lecture portion of the course and laboratory activities and investigations dealing with that same topic. In our general chemistry laboratory courses student would often follow the procedures as described in the laboratory manual and still not be able to answer simple questions or perform routine calculations on that same topic when presented with a practical examination task. Over the past two years we have changed the write-up for many of our laboratory activities to emphasize a more exploratory approach. We have also incorporated laboratory practical tasks as part of our mid-semester and end-of-semester examinations. These changes have encouraged students to think about what they are doing in the laboratory while they are doing it. This talk will present a comparison of the "old" and "new" approaches to the laboratory activities. Sample laboratory practical exam tasks and the results of student work on these practical tasks will be presented.

29A-4 YES VIRGINIA, A DISCOVERY BASED GENERAL CHEMISTRY LAB EXPERIMENT IS POSSIBLE. Linda R. Allen, Department of Chemistry, Xavier University of Louisiana, New Orleans, LA 70125

A new synthesis experiment for the first semester General Chemistry Lab will be discussed. This synthesis of a copper-saccharine compound has been modified for a discovery based approach. This easy synthesis experiment covers the concepts of limiting reagents, theoritical and experimental yields through the use of a bioinorganic molecule, and doesn't require any special equipment. Through open ended discussions, topics of solubility, crystal growth, and analysis of experimental error can be added. This experiment is taught to 20 sections of ~24 students per section in the Fall semester at Xavier University of LA. It demonstrates how an experiment can become discovery oriented for a typical 2½ hour lab session.

29A-5 CONVEYING SOME SENSE OF WHAT CHEMISTS REALLY DO, Richard L. Bivens, Sally R. Hair, Brian P. Reid, Glen E. Rodgers, Martin J. Serra, Ann E. Sheffield, and Edward J. Walsh, Department of Chemistry, Allegheny College, Meadville, PA 16335

As part of a new curriculum instituted nearly four years ago, the chemistry department of Allegheny College offers a one-semester, stand-alone, one-credit laboratory course designed to introduce first-year students to the various subdisciplines of chemistry. The course is divided into modules typically two to three weeks in duration. Each centers around a topic such as the analysis of lipids or dipeptides; synthesis and analysis of oxalato or ammine metal coordination compounds; acid-catalyzed organic reactions; chemical kinetics; molecular energy and motion; and the components of common plastics. Each module is designed, introduced and often graded by a practitioner of the subdiscipline of chemistry appropriate for the module. Lab reports are limited in number but often include a "summary report" in which students are asked as part of a "Follow-Up Session" to summarize what they have learned and apply that knowledge to new situations.

36-1 AN INDEPENDENT STUDY OF ENZYMES AS PART OF THE FIRST YEAR BIOCHEMISTRY LABORATORY. C. Larry Bering, Department of Chemistry, Clarion University, Clarion, PA 16214.

A one credit biochemistry laboratory course offered at Clarion University introduces students to the principal techniques in modern biochemistry including spectrophotometry, chromatography, electrophoresis and centrifugation. In most cases, students are exposed to each technique in a one week experiment. In our course, the final four weeks of the semester are used for an enzymology project in which small groups of two or three students are given an enzyme, an appropriate substrate, and minimal "cookbook" instructions. They are required to prepare all solutions, develop a working assay, and determine kinetic parameters. With the remaining time, they are allowed to use any other techniques to further examine their enzyme. For instance, one group may want more experience in ion exchange chromatography. They must develop a procedure based on the properties of the enzyme, and can use equipment, such as gradient makers and fraction collectors which were not available to the whole class earlier in the term. Several projects, along with the enzymes examined will be described in this paper.

36-2 DETERMINATION OF THE AMINO ACID CONTENT AND STEREOCHEMISTRY OF BIOLOGICALLY ACTIVE PENTAPEPTIDE. Joseph W. LeFevre, Chemistry Department, SUNY at Oswego, Oswego, NY 13126

A common experiment in an undergraduate biochemistry laboratory is the determination of the amino acid content of a dipeptide. The author has expanded the scope of this type of experiment to include a biologically active pentapeptide. The goals of the experiment were three-fold. First, the N-terminal amino acid residue was identified. Second, the remaining four amino acids were identified (but not the sequence), and finally, the stereochemistry of each amino acid was determined. All analyses were done using dansyl-(DNS) derivatives and thin-layer chromatography (TLC). The stereochemical studies were performed on reversed-phase TLC plates using the chiral selector β-cyclodextrin in the mobile phase. The experiment was performed as part of a project-oriented advanced chemistry laboratory at SUNY Oswego. Details of the experiment along with student results will be presented.

36-3 CAPILLARY ELECTROPHORESIS IN THE INSTRUMENTAL ANALYSIS COURSE: DETERMINATION OF ANALGESIC FORMULATIONS. Timothy G. Strein and Hans Veening, Bucknell University, Department of Chemistry, Lewisburg, PA 17837.

Capillary electrophoresis (CE) is a low volume, high efficiency chemical separations technique which has rapidly established credibility in the chemical and biological sciences. The Chemistry Department at Bucknell University was granted an NSF-ILI proposal for the purchase of a commercial CE instrument to expose our undergraduates to this powerful technique with a hands-on experiment in the senior-level Instrumental Analysis course. The first generation of 16 students participated in this pilot experiment in the fall of 1993. The experiment was aimed at the determination of the chemical formulation of pharmaceutical mixtures in analgesic medications. Identical solutions were analyzed using CE and HPLC and students were asked to compare and contrast the two techniques. The experimental design, typical student data and students' reaction to the experiment will be presented.

36-4 UNDERGRADUATE ADVANCED BIOCHEMISTRY LABORATORY: GENETIC MANIPULATION OF PROTEIN STRUCTURE & FUNCTION. D.C. Speckhard, Dept. of Chemistry, Loras College, Dubuque, Iowa, 52004-0178

With the assistance of the Camille and Henry Dreyfus Foundation Inc. we have been able to establish an advanced biochemistry laboratory. The central theme of the laboratory is the beta-galactosidase gene and a continuing series 10 of experiments: 1) Plasmid DNA isolation, 2)DNA synthesis including the polymerase chain reaction, 3)DNA characterization by restriction digestion, 4) Dideoxy sequencing, 5) Site directed mutagenisis by the primer mismatch method, 6) Isolation of the mutant DNA and its characterization as before, 7) Induction of both enzymes in E. coli monitored by protein electrophoresis, 8) Enzyme isolation by column chromatography, 9) Characterization of the protein by gel permeation chromatography and SDS electrophoresis, 10) Kinetic characterization of both enzymes with the substrate o-nitrophenylgalactoside including determining Km, Vmax, pH optimum, temperature optimum, and Ki values for lactose, glucose and galactose .

36-5 AN ADVANCED LABORATORY COURSE AT THE INTERFACE OF CHEMISTRY AND BIOLOGY. C. H. Clapp, M. I. Chernin, J. C. Wallace and K. Garrison, Departments of Chemistry and Biology, Bucknell University, Lewisburg, PA 17837.

An advanced laboratory course in biochemical methods is offered jointly by the Chemistry and Biology Departments at Bucknell. The course emphasizes modern methods for the purification, manipulation and characterization of biological molecules. Experiments include: peptide characterization by hydrolysis, derivatization and HPLC; purification of lipoxygenase from soybeans; enzyme kinetics using a polarographic oxygen electrode; DNA isolation; agarose gel electrophoresis; polymerase chain reaction; insertion of PCR products into plasmids; analysis of recombinant plasmids by restriction digestion and sequencing.

Chemical Researchers, Chemical Journals & Libraries: New Information Technologies in Support of Chemical Education, J. Van Fleet, Organizer *Wednesday Afternoon*

39-1 DO CHEMICAL RESEARCHERS NEED CHEMICAL JOURNALS? DO THEY NEED LIBRARIES? James A. Van Fleet, Reference Librarian/Coordinator for Science and Engineering Resources, Ellen Clarke Bertrand Library, Bucknell University, Lewisburg, PA 17837

These questions are more than rhetorical if we consider the ways in which scientists communicate with each other in the electronic age. The proliferation of electronic resources, including bibliographic databases, online full-text databases, Internet gophers, and electronic journals heralds for some the beginning of the end of the printed periodical. Libraries have become a place through which researchers order pieces of journals. Libraries need to become more proactive in offering support for chemical literature research, regardless of format. Librarians still have a place as information navigators rather than journal collectors. Both librarians and researchers also need to evaluate the new information technologies, and influence their development.

39-2 EVALUATING THE CHEMISTRY JOURNAL COLLECTION IN LIGHT OF DECREASING BUDGETS AND INCREASING USE OF ELECTRONIC ACCESS. Maggie Johnson, Head, Chemistry/Physics Library, University of Kentucky, Lexington, KY 40506-0055

This talk will discuss how the University of Kentucky's Chemistry Library is deciding which journals to keep and which to cancel. Tools used in evaluation are a use study, a citation analysis, availability of electronic substitutes, and document delivery. Chemistry faculty comments and input into the process will also be covered.

39-3 A CHEMICAL LITERATURE MANAGEMENT SYSTEM USING ENDNOTE. Charles Myers, Science Librarian, Martin Library of the Sciences, Franklin & Marshall College, Lancaster, PA 17604-3003; and Ronald L. Musselman, Professor of Chemistry, Chemistry Department, Franklin & Marshall College, Lancaster, PA 17604

A personal literature database can be a significant help in organizing references for planning, interpreting, and reporting research. This is especially useful if means are available for extracting listings from comprehensive databases and if selected references can be incorporated automatically into manuscripts. We report an integrated database system in operation in our laboratory. The current core of the system is the database management and bibliographic generation program, EndNote Plus, from Niles and Associates, with input through Current Contents and Chemical Abstracts.

Conversation: Using Models in Chemistry Teaching, *Wednesday Afternoon*
K. Eichstadt, D. Bagley, Organizers

45-1 SOME THOUGHTS ON MODELS IN INTRODUCTORY CHEMISTRY. Toby F. Block, School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, GA 30332-0400

Although no one can predict with certainty what the burning issues of the day will be in the course of our students' lifetimes, it is probably safe to say that the citizens of the future will be asked to make many decisions based on the predictions of models. We do our students a grave disservice if they hear the term "model" only in connection with the ideal gas law and kinetic molecular theory. We add "injury to insult" if we further tell them that KMT provides a perfect match with our observations and imply that only such perfect models are of use to us. It is my contention that most of what we teach in introductory chemistry courses is based on models. Teaching our students to evaluate their observations and calculated results in terms of these models, and asking our students to see the limitations of these models, may be our most important task.

45-2 MAKING CONNECTIONS IN HIGH SCHOOL CHEMISTRY WITH THREE-DIMENSIONAL MODELS OF BIOLOGICALLY IMPORTANT MOLECULES. Dorothy H. Bagley; Shrewsbury High School 45 Oak Street Shrewsbury MA 01545.

As part of the introduction to organic chemistry in our course, we ask students to build 3-dimensional models of biologically important molecules such as ATP, caffeine, citric acid and sucrose. The activity has provided insights not only regarding the structures of these molecules but to various chemical properties and mechanisms of action. The students have shown great creativity in selecting materials for the models as well as in presentations with them. Models and related classroom activities will serve as a conversation starter.

45-3 EXTENDING THE RUTHEFORD DISCOVERY MODEL. John Penna; Governor Livingston High School, Berkeley Heights, NJ 07922.

Ernest Rutheford drew conclusions concerning the structure of the atom by gathering data. Obeying the dictates of his data, he concluded that the atom consisted of a small dense positive nucleus surrounded by negative electrons which occupied most of the space. He never "saw" the atom but developed his model from his observations. We have used this logic in a mystery box with some external openings. An object is securely placed in the box. Using a marble projectile students must draw conclusions about the shape, position and size of the object in the box. They are never allowed to see the object. They must develop a theory regarding the object in the box. Files have been established over the years as a library of theories which students may analyze. However, never are they allowed to see the object just as Rutheford never "saw" the atom. Their conclusions have only the support of their data.

45-4 USING ANALOGIES TO TEACH FIRST YEAR CHEMISTRY TOPICS, James Daniels, Haddam-Kilingworth High School, Higganum, CT 06441

Careful use of analogies can provide informative bridges to understanding of some of chemistry's harder subjects. Analogies regarding bonding type, chromatography, error calculation, limiting reagents, the Law of Definite Composition, atomic weight calculations, etc. can be used to draw parallels between the easily understood everyday example and its relevant chemical corollary. A brief example: Calculations of absolute and relative (%) error are like bookkeeping tests given to student council treasurer candidates. Candidate one gets a profit from car wash proceeds of $39.41 (correct answer is $39.42) Candidate two gets a profit of the Chrysler Corporation of $1,001,001.01 (correct answer is $1,001,001.02). Can this help the student to better understand the importance of the second error, the relative error? The necessity of drawing the analogies to a close and driving home the point of the analogy will be discussed to prevent these from being just funny little stories.

45-5 A COMPENDIUM OF MODELS AND ANALOGIES FROM THE JOURNAL OF CHEMICAL EDUCATION FOR CLASSROOM INSTRUCTION. Karen E. Eichstadt; Department of Chemistry, Ohio University, Athens, OH 45701

Using the CD rom index of the Journal of Chemical Education we have compiled a list of models that serve an instructive purpose. Some are sophisticated and others are from very simple materials but all serve to enhance the explanation of a chemical concept. The chemical conversation will be initiated with an evaluation of these models.

Teaching and Evaluation of Critical Thinking, U. Zoller, Organizer *Wednesday Afternoon*

47-1 TEACHING AND EVALUATION OF CRITICAL THINKING, Uri Zoller, Haifa University, Oranim, Israel 36910

Critical Thinking, Problem Solving and Decision Making are major issues of concern in contemporary education and science education. Similarly, teaching/evaluation of these higher-level capabilities and higher-order skills are advocated by many, but rarely actually pursued. In this workshop, the state-of-the-art concerning these issues in the context of science teaching/learning in general and college chemical education in particular will be presented, followed by a critical examination/discussion of selected related/relevant foundations, conceptual frameworks and implications for teaching/learning and testing/evaluation. The 'translation' of the above into effective, workable and manageable teaching, examination and evaluation strategies at 2nd and 3rd levels and in the context of chemistry teaching will constitute the focus of the main part of the workshop accompanied by practical illustrative examples which have been successfully implemented and field-tested. This will be pursued via active participation of the audience in working out of new selected examples -- each within his/her own framework of local contraints -- of critical thinking-oriented mini teaching units and corresponding test items.

New Approaches to Teaching Organic Chemistry, R. Minard, Organizer *Wednesday Afternoon*

48B-1 USING THE "DEMONSTRATIONS IN ORGANIC CHEMISTRY" VIDEODISC IN THE CLASSROOM. Gary L. Trammell, Chemistry Program, Sangamon State University, Springfield, IL 62794-9243.

"Demonstrations in Organic Chemistry" is a videodisc designed to provide visual examples of the chemistry of carbon compounds. These demonstrations are intended to increase students' interest and learning by seeing chemical phenomena before analyzing them at the molecular level. The content of this videodisc is designed for use at both the high school and college level. Demonstrations include practical examples, chemistry of commercial materials, and basic techniques us as extraction and thin layer chromatography. In addition to demonstrations, some segments show the use and manipulation of molecular models to illustrated conformations and chirality. Examples of some demonstrations, and the ways I use them in the classroom will be presented.

48B-2 MACINTOSH COMPUTERS IN ORGANIC CHEMISTRY LECTURE AND LAB

Dale E. Marko, Jennifer Z. Gillies, and Elizabeth Winter Wolpaw
Chemistry Department, Siena College, Loudonville, NY 12211

Macintosh computers with commercially available software provide a rich opportunity to enhance organic chemistry teaching in lecture and in laboratory. Our chemistry department has established a Macintosh computer laboratory with funds from the college and from NSF (#USE-9250232) and we have begun to incorporate computer applications in chemistry courses at all levels. In organic chemistry lecture, we use software for visualizing and animating organic reactions, for molecular modelling, and for finding minimum energy structures. In the laboratory, we use IR and NMR simulators to generate spectral unknowns and to teach the basics of IR and NMR instrument operation. We perform energy minimizations to predict laboratory reaction products. We search a data base to find physical and spectral properties of organic compounds used in the laboratory. Our students and faculty have responded very enthusiastically to these additions to our program and we continue to explore new applications.

48B-3 A NEW APPROACH FOR INCLUDING MOLECULAR MODELING IN UNDER-GRADUATE COURSES. J. O. Currie, Jr., Chemistry Department, Pacific University, Forest Grove, OR 97116

For practicing chemists, molecular modeling is rapidly gaining acceptance as an alternative to some laboratory experimentation. As computer power rises and software improves, this trend seems certain to continue. In our year-long sequence in organic chemistry we wanted to include exercises using molecular modeling but with a focus on the use and interpretation of results and not on the computation methods. For three years we have substituted an experiment on aromatic nitration for an experiment modeling the reactivity and selectivity of this reaction. While always successful, the computational procedures frequently distracted students from their results. The advent of modeling project management software such as ProjectLeader from CAChe Scientific has made this goal more attainable. This paper will deal with our previous efforts in modeling and the current approach using ProjectLeader. We believe that molecular modeling has now reached a state whereby it can be used as a tool just as we use NMR or IR, with a primary focus on the results and not the method.

48B-4 ACTIVE LEARNING TECHNIQUES IN THE CHEMISTRY CLASSROOM, Marlene Katz, Department of Chemistry, St. Louis College of Pharmacy, St. Louis, Missouri 63110

Adversity may be an important stimulus for creativity. Changing teaching positions from a small liberal arts college (typical class size = 10-20) to a professional school (typical class size > 100) made former successful teaching methods inadequate. The large class size meant that major adjustments had to be made during the first semester. This was traumatic enough to generate several new active learning methods. This presentation will describe the following active learning techniques, "Intellectual Ping-Pong," the "Where's Waldo?"© Exercise, "The Choreography of Chemistry," "Active Learners Row," and various group learning activities. The relationship between each technique and some aspect of critical thinking will be explained. These activities have been especially helpful in communicating abstract concepts. Changes in the student's perceptions of abstract concepts will be described. A few of these techniques will be modeled using audience members.

48B-5 Lillian D. Berg, Northern Virginia Community College, Annandale, VA 22003
CRITICAL THINKING: PREDICTOR OF SUCCESS IN ORGANIC CHEMISTRY?

Scrutiny of the success of 200 students enrolled in Organic Chemistry revealed a direct correlation between a Critical Thinking (Watson-Glaser) Test score and the grade received for the first semester of Organic Chemistry. The prerequisites of College Chemistry and English Composition, in-class chapter testing and in-lab report writing during the first two weeks of the term also gave clues as to the student's readiness for the course. Deficiency in any one of these factors led to consultation with the student, a possible withdrawal from this level of Organic, completion of prerequisites, and/or enrollment in a lower level of Organic Chemistry.

48B-6 TAKING A BACK SEAT IN THE CLASSROOM. Eve Wildi, Department of Chemistry, Nazareth College, 4245 East Avenue, Rochester, NY 14618.

Many small changes in the pedagogy of organic chemistry at Nazareth have reclaimed it from its former status as the most fearsome course in the sciences curriculum. Non-science majors now enroll in organic chemistry as a free elective! Students prepare well for this interactive class because each period opens with a one question quiz. During these quizzes the instructor gets an instant picture of the participants' level of understanding of the day's lesson material. Lecture is then limited to reinforcement for the weakest areas. The remaining class time may then be very profitably spent in discussions of relevant current events, and variety of problem solving activities. Two walls are paved in chalkboard so that all of the class may work there simultaneously. The instructor coaches in problem solving strategies, including collaborative work. Individual competition is thereby minimized, while games and contests played in pairs or teams take advantage of students' energy and drive for success.

48B-7 STUDENT-DIRECTED LEARNING: A TECHNIQUE WHICH PROMOTES INDEPENDENCE AND RESPONSIBILITY IN THE STUDENT. Marlene Katz, Department of Chemistry, St. Louis College of Pharmacy, St. Louis, Missouri 63110

Student-Directed Learning (SDL) is a successful way to ensure active learning by putting students in charge of what happens during the class session. The objectives of this method are: to make the most effective use of classroom time by addressing the specific interests and needs of the students; to encourage students to become more independent in the learning process, to develop increased responsibility on the part of the student, to encourage students to become active learners, and to promote understanding as the goal of the course (to have students become "information processors" instead of 'information carriers"). This presentation will explain the methods used in SDL and outline the process of implementing SDL in a Sophomore Organic Chemistry course. The procedures currently used are introduced gradually over two semesters, but could be adapted to a one semester course. SDL requires careful planning and sensitivity, on the part of the instructor, to the changing needs of the class as they begin to take charge of their own learning.

48B-8 A DISCOVERY-BASED APPROACH TO SOPHOMORE-LEVEL ORGANIC CHEMISTRY.

Frank J. Creegan, Department of Chemistry, Washington College, 300 Washington Avenue, Chestertown, Maryland 21620-1197.

We have developed a series of Discovery-Based experiments involving acid- and base-catalyzed eliminations, electrophilic and nucleophilic aromatic substitutions, nucleophilic aliphatic substitutions, and nucleophilic additions which require students to collect and analyze data and to share their results with team and/or class members. Minimal information concerning underlying theories and reaction procedures is provided. Product identification is achieved either spectrometrically or by capillary GC/MS. Students are asked to propose reaction mechanisms consistent with observed results which then form the basis for either a written or oral report. Details of specific experiments, student experimental results, and student reactions to this new approach will be discussed.

Lasers in the Undergraduate Curriculum, V. Walters, J. de Paula, Organizers *Wednesday Afternoon*

49B-1 MULTIPLE USES OF A NITROGEN LASER IN THE UNDERGRADUATE CURRICULUM.

Valerie A. Walters, Department of Chemistry, Lafayette College, Easton, PA 18042

A nitrogen laser system is used in both the physical chemistry laboratory course and faculty-directed student research at Lafayette College. Two laboratory experiments utilize the laser and associated electronics. Slightly different configurations of this equipment permit the laboratory students to acquire the Raman spectrum of carbon tetrachloride and the two photon absorption spectrum of phenanthrene. The same laser system, with some modifications, can also be used by student researchers to obtain phosphorescence and triplet-triplet absorption spectra to investigate properties of the triplet states of molecules, in our case, porphyrins. Lifetime studies of the triplet states are also done. The multiple uses of the nitrogen laser system at Lafayette College illustrate the versatility and usefulness of the laser equipment.

49B-2 HIGH-RESOLUTION LASER SPECTROSCOPY IN THE PHYSICAL CHEMISTRY LABORATORY.

Joseph M. Brom, Department of Chemistry, University of St. Thomas, St. Paul, MN 55105

A standard physical chemistry laboratory exercise is the study of a relatively simple atomic spectrum. A particularly worthwhile example is the study of the atomic emission spectrum of Na. Whereas one observes only members of the P series of Na in absorption from the 3^2S ground state, one can observe several members of the S, P, and D series in emission. Important concepts illustrated in the Na spectrum include: ionization energies, quantum energy levels, quantum numbers, quantum selection rules, quantum defects, and spin-orbit coupling. Using a single mode diode laser in an optogalvanic detection scheme, we have developed a high resolution absorption experiment of Na which complements the study of the emission spectrum. By probing absorption from the 3^2P excited state, and not from the 3^2S ground state, the investigation illustrates the capabilities of high resolution laser spectroscopy and the finer details about selection rules involving spin-orbit components.

49B-3 **PHOTOCHEMISTRY OF RUTHENIUM(II) POLYPYRIDYLS.**

Julio C. de Paula, Robert C. Scarrow, and Lynne Hurwitz, Department of Chemistry, Haverford College, Haverford, PA 19041

Students in our junior-level integrated laboratory course study the photochemistry of Ru(II) *tris*-bipyridyls, $Ru(bpy)_3^{2+}$, with a nitrogen-laser-pumped dye laser and time-resolved, gated fluorescence detection. The luminescence from the metal-to-ligand charge transfer (MLCT) state of $Ru(bpy)_3^{2+}$ is quenched via photo-induced electron transfer to a number of inorganic, organic, and biological compounds. In the past, students used $Fe(H_2O)_6^{3+}$, $Fe(CN)_6^{3+}$, quinones, and cytochrome *c* as quenchers. We will describe in detail a project where the thermodynamic driving force of the electron transfer reaction is changed by using differently-substituted quinones. The attendant changes in the rate constant were interpreted in terms of Marcus's theory for electron transfer in the condensed phase.

This work was supported by the Pew Charitable Trusts and the Howard Hughes Medical Institute.

49B-4 LASER-INDUCED FLUORESCENCE STUDIES OF MOLECULAR COLLISION DYNAMICS. Thomas A. Stephenson, Department of Chemistry, Swarthmore College, 500 College Avenue, Swarthmore, PA 19081.

Laser-induced fluorescence experiments have been a part of the physical chemistry laboratory curriculum and the undergraduate research program at Swarthmore College since 1987. In the most successful physical chemistry experiment, we use time-resolved methods to explore the self-quenching of molecular iodine following excitation to the B electronic state. Students fit the exponential fluorescence decays and extract depopulation rate constants for a series of total iodine pressures. A Stern-Volmer analysis then yields an effective collision cross section that can be compared with that derived from a hard sphere calculation. In our undergraduate research program, two color, pump-probe laser-induced fluorescence is the principal experimental tool in our examinations of (1) the collision dynamics of highly electronically excited diatomic halogen molecules and (2) the photodissociation dynamics of rare gas/halogen van der Waals complexes.

49B-5 LASERS IN UNDERGRADUATE PHYSICS AND ELECTRICAL ENGINEERING: PEDAGOGICAL AND RESEARCH APPLICATIONS

Lynne A. Molter
Swarthmore College, Departments of Physics and Engineering, Swarthmore, PA 19081

A brief review of pedagogic uses of lasers in the Physics or Electrical Engineering curriculum will first be presented. Studies of a diode-pumped YAG laser, EEG's taken using a He-Ne or diode laser, experiments with diode lasers, experiments with an open-cavity He-Ne laser, holography, guiding of laser beams and optical fibers, interference of laser signals, and spatial Fourier transforms using laser beams are among the applications that will be highlighted.

The second portion of the talk will be a description of undergraduate research projects using lasers. Examples of these topics include Erbium-doped fiber amplifiers and lasers, microwave modulated waveguide switches and structures, studies of nonlinear devices and materials, characterization of the fluid mechanical properties of liquids and drops, and the use of interferometry to measure vibrations of acoustical devices such as ultrasound transducers.

49B-6 GAS-PHASE FRAGMENTATION PATTERNS IN ORGANOMETALLIC COMPOUNDS: UNDERGRADUATE RESEARCH USING AN EXCIMER-PUMPED DYE LASER. William E. Hollingsworth, Department of Chemistry, Carleton College, Northfield, Minnesota 55057

A variety of experiments were performed to elucidate fragmentation patterns in isolated, gas-phase metal carbonyls containing metal-metal bonds. The focused beam from either an excimer laser or a tunable dye laser pumped by the excimer resulted in an efficient, multiphoton process leading to the break-up of the molecule and ultimate ionization of the surviving small metal fragments. These atomic and molecular metal ions were detected in a time-of-flight mass spectrometer. Resonance enhancement in ion production from tuning the dye laser yielded direct and detailed spectroscopic information on the transients produced in the fragmentation process.

This research was performed by undergraduates during periods of summer research and independent study. This talk will highlight aspects of this research which pertain to specific issues encountered in doing laser research in an undergraduate setting. In particular, issues of cost (both start-up and maintenance) and continuity (due to working with students for a relatively short time) will be addressed.

49B-7 **POLARIZED ABSORPTION/EMISSION - A NEGLECTED TECHNIQUE.** B. A. DeGraff and Lisa Christianson, Department of Chemistry, James Madison University, Harrisonburg, VA. 22807.

The use of polarized light to probe both structural and micro-environmental information has been know for many years. There is currently a renaissance for the techniques as applied to biological systems and the general study of microheterogenous media. With the advent of inexpensive lasers and other components, these techniques are quite suitable for undergraduate experiments. Such experiments are moderate in cost, easy to set up, and introduce the students to a number of very novel and useful ideas. And, they are representative of currrent practice.

A low cost, easily assembled, laser based instrument will be described for polarized emission measurements. Experiments, with typical data, using these techniques will also be shown. Copies of the experiments will be available to those interested.

Is An Associate Degree Detrimental to an Academic Future?

Wednesday Afternoon

J. Herron, M. Schumm, Organizers

55-1 FORD FOUNDATION SUPPORTED STUDY, "STATE HIGHER EDUCATION SYSTEMS AND COLLEGE COMPLETION", AUTHORS: G. ORFIELD AND F. PAUL J. Dudley Herron, Morehead State University, Morehead, KY 40351-1689 and Margot K. Schumm, 4908 Melinda Court, Rockville, MD 20853

The Orfield/Paul study will be discussed. The author's purposes for undertaking this study, the assumptions they made and the methodology they employed will be described. The interpretations of thedata collected and the conclusions reached by the authors of the study will also be presented.

55-2 IS AN ASSOCIATE DEGREE DETRIMENTAL TO AN ACADEMIC FUTURE? A STUDY OF A NATIONAL SAMPLE OF STUDENTS. Dr. Charlene R. Nunley, Chief Administrative Officer, Montgomery College, Rockville, Maryland

This presentation summarizes research findings that are more positive about the effect of community college student educational achievement than some previous studies. It concludes that:

> "When the efficiency of community college baccalaureate preparation is viewed in the broader context of all possible post high school choices available to those who desire a bachelor's degree, community college attendance...is positively related to years of education achieved and to baccalaureate degree achievement."

The author will present the findings of her research.

55-3 THE COMMUNITY COLLEGE ROUTE RETRACED. Don R. Brown, Purdue University, West Lafayette, IN

The data from the Ford Foundation study were reanalyzed. In the original study, a comparative analysis of data from five states led to the conclusion that the structure of higher education is an important determinant of the percentage of students attaining bachelor's degrees. Reanalysis of the data does not support that view as strongly as does the original analysis. Upon reexamination, it is not at all clear that structure is a critical determinant of college success as measured by degree attainment.

55-4 IS AN ASSOCIATE DEGREE DETRIMENTAL TO AN ACADEMIC FUTURE? Barbara J. Keener, Dean of Academic Affairs for Community College Relations and University Ombudsperson, University of Florida

The speaker will examine current strategies for successful community college-to-university transfer as exemplified by the Florida articulation model. This model is based on Associate degree completion as the stepping stone to Florida senior institutions. Research reflecting community college transfer student performance in the senior institutions will be highlighted with an emphasis on students enrolled in engineering and other science related majors. Additional data on the impact of Florida's articulation policies will also be reported.

55-5 STORIES FROM THE MARGIN: THE USES OF THE COMMUNITY COLLEGE.
John O. Stevenson, Jr., PhD, LaGuardia Community College, 31-10 Thomson Avenue, Long Island City, NY 11101

The presentation will argue that the community college cannot be appropriately understood as the "first two years" of a baccalaureate experience. The community college has many uses, one of which is indeed the transfer function, but an equally important use is the creation of "bachelor's bound" desire in students who would not otherwise have such motivation. Case histories will be presented of LaGuardia students who entered the college with narrowly defined career objectives, but who now are proceeding towards bachelors' degrees in the sciences with the support of NSF and NASA. Indeed government agencies which support scientific education now see the urban community college as an important part of the "pipeline to science" for minority and other under-represented students.

55-6 A.S. DEGREE AS STEPPING STONE TO AN ACADEMIC FUTURE, Hiroko I. Karan, John Flowers, Department of Physical Sciences and Computer Science, School of Science, Health and Technology, Medgar Evers College, City University of New York, Brooklyn, N.Y. 11225

Does an Associate Degree preclude an academic future? It depends on how the A.S. degree curriculum is structured and whether the degree program is enriched with supplemental programs such as orientation to research and supported by career counseling, academic advisement, tutorials, etc. At Medgar Evers College, students in the A.S. degree programs n Science have opportunities to participate in research orientation programs through a Bridge Program in addition to research projects both in the college and at nearby institutions. These activities are supported by grants that are administered by four years institutions in collaboration with colleges offering A.S. degrees in the New York Metropolitan Area. We have found A.S. students respond favorably to these research opportunities and became motivated to pursue a Bachelors degree in science or engineering even though these degrees seemed unattainable when they first came in to the college.

Research in Education - Examples, P. L. Samuel, Organizer *Wednesday Afternoon*

57D-1 EFFECTS OF AN INTEGRATED VIDEO-ENHANCED HIGH SCHOOL CHEMISTRY CURRICULUM ON STUDENT ATTITUDES AND ACHIEVEMENT. W.S. Harwood, M. McMahon, L. Ragsdale, N. Ben-Zvi, Department of Chemistry and Biochemistry, University of Maryland, College Park, Maryland 20742

An examination of the achievement and attitude differences between high school students who experience a general chemistry course enhanced with The World of Chemistry video series (eight video-enhanced micro-units per semester) and those students who receive no video-enhanced media interventions within their general chemistry course. Twenty high school chemistry teachers and over 600 high school chemistry students participated in this experimental study. In addition, a detailed case study was conducted on a small sample of chemistry students in a typical high school class. Preliminary results indicate reason to suspect significant achievement and attitude differences between the treatment and control groups. Final results will be reported.

57D-2 AUTHENTIC ASSESSMENT IN THE HIGH SCHOOL CHEMISTRY CLASSROOM. Maria R. Walsh, Pike High School, 6701 Zionsville Road, Indianapolis, IN 46268

For the past ten years, I have taught a chemistry course for high school students in which I present materials to reach a variety of learning styles. Until recently, however, I tested my students using only one kind of test, the multiple-choice. I am now aware that I have not been making use of the wide variety of available assessment opportunities. I will describe authentic assessment and share with you my first attempts and successes at using authentic assessment in my chemistry classroom.

57D-3 STUDENT EXPERIENCES IN COLLEGE GENERAL CHEMISTRY: AFFECTIVE INFLUENCES ON DECISIONS ABOUT MAJORING IN SCIENCE. Lee Meadows, Department of Curriculum and Instruction, University of Alabama at Birmingham, Birmingham, AL 35294.

Analysis of students' experiences in college general chemistry created a two-step decision making process for continuing in a science or science-related major. Students first had to be successful in general chemistry: Non-successful students dropped out. Students also had to retain a positive attitude about continuing their science major: Students who developed a negative attitude also dropped out. Results from the the study were drawn from quantitative data analyzed using LISREL (N=598) and from qualitative data analyzed using principles for generation of grounded theory (N=17). Results debunked traditional views of students success such as the importance of academic background, mathematical preparation, or students' like or dislike of science. The study indicates the need for pedagogy that facilitates student success, use of study groups, smaller class size, and a less-is-more approach to content coverage.

57D-4 A QUALITATIVE STUDY OF THE EFFECTS OF A CONSTRUCTIVIST METHOD OF LABORATORY INSTRUCTION ON COLLEGE STUDENTS' CONCEPTUAL CHANGE, ACHIEVEMENT, ATTITUDE, AND PERCEPTION. D. Lewicki, Math/Science Division, Sage College of Albany, Albany, New York 12208.

This study compared learning, attitudes, and perceptions for two types of laboratory instructional methods of beginning college chemistry students. The two types were (1) the constructivist method characterized by conceptual integration, planned episodes of student inquiry, guidance for conceptual change, and social interaction, and (2) the verification method characterized by an inform-verify-practice sequence with students working independently. Eight students participated in weekly interviews that focused on: (1) background of student, (2) attitude toward laboratory, (3) role of laboratory in learning chemistry, (4) chemical concepts learned in the laboratory, (5) the instructional method, and (6) connection of activities from week to week. Analysis of the case studies revealed that significant changes in cognitive growth occurred with both methods. Three students who experienced the constructivist treatment, however, compared to three who experienced the verification treatment: (1) were more highly motivated, (2) revealed positive attitudes toward laboratory work, and (3) perceived the importance of the laboratory in learning chemistry.

57D-5 LEARNING CHEMISTRY IN THE CLASSROOM BY DOING CHEMISTRY INNOVATIVELY. Lee Meadows and Linda Grynkewich; Department of Curriculum and Instruction, University of Alabama at Birmingham, Birmingham, AL 35294, and Department of Science Education, University of Georgia, Athens, GA 30602.

We turned chemistry teaching on its ear by moving from traditional, teacher-centered lecture to an innovative, cooperative, student-centered approach. The results were very pleasing. In traditional classrooms, often only the best and brightest succeed. In our classroom, 80% of the students earned A's or B's by a good understanding of chemistry. Even students with poor motivation or poor academic backgrounds succeeded. Also, the students exited the class with positive attitudes about continuing their science or science-related majors. Cooperative learning was central to our approach. We also emphasized student-initiated problem solving over teacher modeling, objective mastery assessment rather than normative assessment, depth of knowledge coverage over breadth of knowledge, nurturing relationships over academic distance, and sound assessment over ease of grading.

57D-6 PROBLEM-SOLVING TECHNIQUE USED IN TEACHING INTEGRATED SCIENCE. T. A. Asunta, Department of Teacher Education, University of Jyvaskyla, SF-40351 Jyvaskyla, Finland

Differences between preconceptions and the students' ways of hypothesizing and solving science problems were studied. The goal was that every student would have an active, hands-on role during laboratory session. I tried to find out whether there are differences between boys' and girls' former knowledge, ability, attitudes and self-confidence to solve problems. Students attending this study were ages from 9 to 12 years and 1st and 2nd year primary level student teachers ages from 18 to 35 years. There were no notable differences between hypotheses of these groups or sexes. Attitudes and enthusiasm towards the problems were also quite equal and all groups were sure that they could solve the problems. The only significant difference within each group was the working rate: some pairs needed only half the time of others.

57D-7 EXPLORATORY RESEARCH RELATED TO LABORATORY INSTRUCTION AND ITS LEARNING OUTCOMES IN CHEMISTRY & ACROSS THE SCIENCES. A. Hilosky, J. Schmuckler, F. Sutman, M. Zhou, Science Education, Ritter Hall, Temple University, Philadelphia, PA 19122

While over 600 articles and reports of studies concerning the role of laboratory experiences in science instruction, grades 7-14, have appeared in the literature since 1970, most have been expressions of opinions about the nature of laboratory instruction based upon answers to questionnaires or opinionnaires or based upon the personal beliefs of professionals. About 150 of the articles have reported conclusions based upon procedures designed to measure desired instructional outcomes. About 100 of the 150 have been based on the analysis of data collected through actual observations of laboratory instruction itself; and there has been no statistical synthesis of past research results through the use of meta-analysis. Studies related to the results of laboratory instruction in chemistry comprised a small percentage of the total studies that could be subjected to such analysis. Therefore, the study to be reported included a meta-analysis of past studies across all of the sciences with the knowledge, supported by literature, that the results of studies in one science are applicable to all of the sciences including chemistry. The study to be reported, then, includes results obtained from a meta-analysis of the data from about 100 of the earlier studies, as well as from data obtained from direct observations of instruction in a sampling of 66 pre-, post- and laboratory situations conducted in a sampling of 42 high schools and colleges. The analysis of these observations have been complemented by the results of detailed ethnographic interviews of: the laboratory instructors, a sampling of students who were involved in the laboratory based instruction, and administrators responsible for support of this form of instruction. The above indicates that the purpose of the study to be reported was to obtain a comprehensive description of laboratory instructional practices and an indication of the learning outcomes of such practices.

59-4 SCIENTIFIC CREATIVITY: GEDANK EXPERIENCES IN COLLEGE CHEMISTRY.
Amina K. El-Ashmawy, Collin County Community College, 2800 East Spring Creek Parkway, Plano, Texas 75074

The Gedank experience - learning exercises that actively involve students in observation, organization and analysis of real or imaginary scientific problems - provides a uniquely creative learning/teaching format for students and faculty at CCCCD. This session will consist of a brief presentation, hands/minds on exercises and will require active participation from the audience.

59-5 CHEMISTRY THROUGH THE AGES. Nancy LeMaster, D. W. Daniel High School, Central, SC 29630, Elizabeth Martin, Univ. of Charleston, Charleston, SC, and Denie Ravenel, Ashley Hall, Charleston, SC

Explore the possibility of using foods, food preparation, and food preservation as a teaching tool. Investigate one of the oldest applications of chemistry by looking at textiles and dye materials. Relate the structure of molecules to their function in biological systems and as medicines. Introduce the periodicity of elements in a colorful way. Approach chemistry from the historical perspective.

59-2

A WORKSHOP IN WRITING SUCCESSFUL PROPOSALS. Martha K. Turckes; American Chemical Society, 1155 Sixteenth Street, NW, Washington, DC 20036.

There is a huge amount of grant money available for those who:
a) are aware of it, and
b) know how to ask for it in a persuasive and convincing way.

This session is designed to help teachers out in both areas. Participants will learn proposal writing techniques using strategies that have proven effective. Various grants available for K-12 science teachers will be discussed and a list of funding sources will be distributed.

Plenary Address *Thursday Morning*

P-5 DOING CHEMISTRY AT THE ART/ARCHAEOLOGY INTERFACE.
Mary Virginia Orna, College of New Rochelle, New Rochelle, NY 10805.

The methods of modern chemistry can be used as probes to examine the provenance and to aid in the conservation of art objects and artifacts. In addition, these methods can help enormously in clarifying the techniques by which these objects were made, in determining their content, and in dating their origins. A variety of methods will be illustrated in the examination of such materials as medieval stained glass and manuscripts, Middle Eastern obsidian and pottery, 20th century art forgeries, the Vinland Map and the famous Shroud of Turin. Although such methods can give great insight into the objects in question, there are limits to such technology; these limitations will also be discussed.

13C-1 TEACHING ORGANIC CHEMISTRY WITH TEAM LEARNING AND CASE STUDIES.
Frank J. Dinan; Joseph F. Bieron, Department of Chemistry, Canisius College, Buffalo, New York 14208

A team learning method, extensively modified for use in teaching organic chemistry has been introduced and tested in the introductory organic chemistry course at Canisius College. Details of the team learning procedure, and the results obtained form cognitive and affective evaluations of the method will be described. The case study method is being used in conjunction with team learning in this experimental organic chemistry course. The use of case studies allows the introduction of a number of important social issues into the course which would otherwise be difficult to fit into an introductory level science course. It allows the "critical thinking" dimension of the course to be greatly expanded. Our experience with the case study method will also be described.

13C-2 INTERACTIVE LEARNING IN THEMATICALLY INTEGRATED FRESHMAN CHEMISTRY.
Fred Garafalo and R. Toomey, Mass. College of Pharmacy, 179 Longwood Ave. Boston, MA 02115 and V. LoPresti, Wheelock College, 200 the Riverway, Boston, MA 02215

This presentation will report on the status of an NSF-funded project to incorporate active learning strategies into our freshman chemistry curriculum. The approaches we are employing include the Gutenberg and TAPPS methods, HyperCard stacks containing two-tiered question sets, and the use of unifying themes to help students organize knowledge. The talk will address the problems as well as the benefits associated with using these techniques, and describe assessment procedures that we use to provide guidance in developing and restructuring course content. Specific examples of the way that course content is structured to help students master scientific vocabulary, develop thinking skills, and gain a better appreciation of chemistry and its relationship to the other natural sciences will be discussed.

13C-3 **USE OF LINKED MULTIPLE-WINDOW COMPUTER VISUALIZATIONS TO DEVELOP MENTAL MODELS OF CHEMICAL CONCEPTS.**
J.W. Russell, Department of Chemistry, Oakland University, Rochester; MI 48309, R.B. Kozma, P. Baggett, J. Davis, T. Jones, and N. Marx, School of Education, University of Michigan, Ann Arbor, MI 48109.

The ability to show simultaneous, synchronized multiple representations (symbolic, actual experiments, microscopic animations, and dynamic graphs) of chemical phenomena has been demonstrated to help students build more expert-like mental models. Pre/post test results of initial classroom use of 4M:CHEM show gains in conceptual understanding and declines in misconceptions of chemical equilibrium. Studies with individual students allow identification of specific 4M:CHEM components which trigger specific learning events. Understanding of the dynamic nature of chemical equilibrium results almost exclusively from observation of microscopic level animations. For several students an understanding of the effect of temperature upon equilibrium distributions resulted when links were made between two or three representations. The results of these studies will be presented with those from subsequent ones designed to probe in greater depth what students learn from viewing individual and coupled representations. 4M:CHEM is being demonstrated in a separate session.

13C-4

HYPERMEDIA PRESENTATIONS ON A PC; TOOLS TO SMOOTH THE PATH, Charles R. Ward and James H. Reeves, Department of Chemistry, University of North Carolina at Wilmington, 601 S. College Rd., Wilmington, NC 28403.

Most of the software options available for developing hypermedia classroom presentations fall into one of two categories, too restrictive or too complicated. In a teaching environment, presentations should be flexible, so that unanticipated questions or comments can be fully explored without loosing the overall coherence of the lesson. However, software that provides this level of sophisitication (such as *Toolbook* by Asymetrix Corp.) often requires a significantly longer time to program, limiting its utility for ongoing classroom preparations. As part of the NSF funded *MCP Project*, software tools have been created to facilitate the development of hypermedia classroom presentations using *Toolbook*. These tools will be demonstrated using hypermedia equipment similar to that employed in our classrooms.

13C-5 DON'T JUST LECTURE ON CHEMISTRY, PRESENT IT. Monica M. Ali, Department of Chemistry, Oxford College of Emory University, Oxford, GA 30267

Today's students are accustomed to receiving information in a video and computer world through television and other electronic methods. In order to provide instruction to students in a medium with which they are familiar and comfortable, computer graphics can be used along with the traditional lecture to teach chemistry courses. Presentation graphics software packages can present slow motion animation and other effects as well as graphs and tables of information. Such programs permit an instructor to produce illustrations that would traditionally be prepared at a blackboard or on an overhead projector. Enhancements are added to the basic set of illustrations to improve the quality of the presentation and to present concepts not easily explained by traditional, hand-drawn illustrations. The slides used in a presentation can be printed as handouts or produced as a runtime (diskette copy that does not require the basic program for operation) for student study outside of class. This paper will demonstrate preparation of material for a single topic. A brief sample lecture will be given.

13C-6 COLLABORATIVE LEARNING OF STOICHIOMETRY

Vickie L. Hess; Indiana Wesleyan University, Marion, IN 46953

Students come to our General Chemistry classes with a variety of backgrounds and also with little experience of learning actively in groups. Rather than either assume prior knowledge or lecture through stoichiometry, I have used an approach in which small groups were held accountable for seeing to it that their members mastered basic concepts and for producing group solutions to a challenging set of problems. Most students enjoyed the process; almost all felt that they learned from it.

14-1 THE COMPUTER: A TOOL FOR CHEMICAL EDUCATION RESEARCH. D. S. Domin, Department of Chemistry, University of Wisconsin Centers-Manitowoc, Manitowoc, Wisconsin 54220 and G. M. Bodner, Department of Chemistry, Purdue University, West Lafayette, Indiana 47907.

Computers have entered almost every part of our lives, both privately and professionally. A common component of the chemistry research lab, it is not surprising that computers are beginning to play a role in research in chemical education. This paper will describe a recent project in which a computer was used as a research tool to probe the cognitive operations of successful and unsuccessful problem solvers. In this project, the computer was used to: (1) present information, (2) provide feedback on progress, and (3) acquire data. In the course of this paper, the authors will describe the advantages and disadvantages of using computers for each of these categories. Suggestions will also be made as to the appropriate use of computers as a tool to assist research in chemical education.

14-2

Evaluating the Use of Computers in the Chemistry Classroom. B. James Hood, Department of Chemistry & Physics, Middle Tennessee State University, Murfreesboro, TN 37132.

When the chemistry teacher selects educational software, there is always some apprehension that the programs may not "work" in her/his own classroom. There are evaluation forms that the teacher can use to make a preliminary review of the software, but often the most important evaluation can be made while the students use the program. This presentation will provide some guidance for teachers who desire to more adequately determine a program's usefulness prior to making large investments in site licenses or multiple copies. The participants will have the opportunity to perform hands-on evaluation.

14-3 PROBLEM SEQUENCING STRATEGIES IN COMPUTER BASED INSTRUCTION. Michael P. Doherty, Department of Chemistry, East Stroudsburg University, E. Stroudsburg, PA 18301; and George M. Bodner, Department of Chemistry, Purdue University, W. Lafayette, IN 47907

A computer program provided instruction in molecular geometry to students at a comprehensive 2-year college and a land-grant university. In a hybridization lesson, the computer randomly assigned each student to one of three treatment groups. The sequence of practice problems differed among the treatment groups, so as to provide (1) a linear sequence of two problems at each of five difficulty levels, (2) maximum user control, or (3) a programmed mastery strategy. A 10-question post-test showed no treatment effect among students at the land-grant university. However, students at the 2-year college in the user control group scored significantly lower than students in the other groups. Computerized timed records of problem sequences revealed the crippling choices of less successful students.

14-4 EVALUATION OF REQUIRED CAI USE BY FRESHMAN CHEMISTRY STUDENTS. James D. Spain, Dept. of Chemistry, Clemson University, Clemson, SC 29634-1905

Clemson University is in the seventh year of a program that requires computer assisted instruction (CAI) as part of a freshman chemistry course involving over 1000 students per term. Since required use of CAI represents a departure from what is carried out in most college chemistry programs, we have been interested in finding out what the student perceptions were about this teaching strategy. The system uses a series of 24 IBM-based programs specifically designed to meet the major learning objectives of general chemistry and covers most of the major topics, including thermodynamics, nuclear and organic chemistry. Five percent of the final grade is given for successfully completing the assigned programs. Typically, about 85% of the students complete 10 or more of the 12 programs assigned during a given term.

The use of required CAI has been evaluated by more than 4000 students during the last 5 years of operation. This evaluation took the form of a questionnaire, usually distributed during the last week of classes each term. Questions were in the multiple choice format, in which students expressed their perceptions of CAI use and how it compared to other aspects of the course. During the past year the responses were submitted on computer scan sheets, and analyzed using the spread sheet program EXCEL. Results have consistently shown strong support for the use of required CAI. The majority of students rate it as one of the strengths of the course. Especially strong support is given by the better students in the class and by females as compared to males. Other interesting comparisons will be discussed.

Computer Applications in the Classroom & Laboratory, *Thursday Morning*
G. Sibert, P. Samuel, Organizers

15E-1 BOOGIE AT THE DISCO __ USING NCSA TOOLS ON THE MACINTOSH TO MODEL ATOMS AND MOLECULES, Barry E. Rowe, NCSA ChemViz Group, University of Illinois, Champaign, IL 61820

With a Macintosh and Internet access, high school Chemistry students and teachers can use high powered computing and communications skills to visualize atomic and molecular orbitals. The NCSA ChemViz project has generated Macintosh software that makes interaction with the NCSA Cray Y-mp super computer transparent for Internet users and possible for modem users. Instructive, beautiful and computationally correct images are returned to be viewed on Macintosh computers in high school Chemistry classrooms by students and teachers.

15E-2 CD-ROMS FOR CHEMISTRY TEACHERS, H. B. Brooks, Synaps, Lincoln, Nebraska 68510-2107, and D. W. Brooks, University of Nebraska, Lincoln, Nebraska 68588-0355.

CD-ROMs promise to be a very effective source of information for chemistry teachers. Modern ROMs can hold a great deal of information, including motion-color images for play back on an ordinary color monitor of a modern computer. This talk will comment on four CD-ROMs currently available. Doing Chemistry, published by the American Chemical Society as a six-sided videodisc series in 1989, has been converted to a single ROM. The ChemSource project, published as four large paper texts in late 1993, is available as an electronically searchable ROM. The visualizations produced by John Gelder for an Advanced Placement Chemistry by Satellite project are available. All three of these projects enjoyed support from the National Science Foundation. SmallScale, a CD-ROM-based laboratory manual of small scale laboratory experiments for high school and college classes, was developed by Synaps. The ROM format is less expensive and, in many ways, more versatile than the predecessor formats. This talk will demonstrate CD-ROM technologies for chemistry teachers.

15E-3 VIZQUIZ - A MULTIMEDIA VEHICLE FOR TEST AND HOMEWORK EVALUATION

Robert D. Allendoerfer, Department of Chemistry, University at Buffalo, Buffalo, NY 14214-3094, James A. McCormick, John W. Moore, Department of Chemistry, University of Wisconsin-Madison, 1101 University Ave., Madison, WI 53706-1396

VizQuiz is a computer program for Microsoft Windows which allows students to take a quiz at a computer much as they would take a quiz on paper, but with the added advantage that color graphics, animations and video clips can be included in the questions. Four types of questions are available: multiple choice, grouped binary choice, one word text answer, and single numeric answer. At the instructors option, one or more spelling errors can be forgiven in text answer questions. Accuracy and precision (significant figures) can be judged separately in numeric answer questions. Control of student access, grading, and grade recording are all handled by the computer with a minimum of human intervention. The presentation will demonstrate the program's multimedia capability as well as its ability to provide hints, remedial feedback, worked out solutions, and instantaneous grading. The program is currently being used in our general chemistry discussion sections to evaluate homework assignments and to give sample quizzes.

15E-4 HYPERCARD AND DESKTOP PUBLISHING IN THE HIGH SCHOOL CHEMISTRY CLASSROOM. M.G. Sibert, Roanoke Valley Governor's School for Science and Technology, 2104 Grandin Road, SW, Roanoke, Virginia 24015.

High school students tend to be fascinated by HyperCard or desktop publishing or both. Assigning a choice of either medium as a way of having chemistry students demonstrate what they have learned about a topic is sometimes as good a method for assessing learning as a paper and pencil test. Many students will work harder, and dig deeper, with fewer complaints to learn all they can about a topic so they can create a brochure or stack that will impress their friends, as well as the teacher. Examples of assignments and products will be shown.

15E-5 CHEMPROF: TEACHING EQUATION BALANCING

Arthur A. Eggert, Catherine H. Middlecamp and Anthony T. Jacob
Chemistry Learning Center, University of Wisconsin-Madison, Madison, WI 53706

The ability to balance chemical equations is an essential skill for setting up chemical experiments and predicting the amounts of product possible. To balance equations, a student needs to choose a viable set of chemical formulas for reactants and products, select one of a number of possible strategies for balancing (e.g., inspection, half-reaction method) and then implement it.

The development of Intelligent Tutoring System (ITS) technology permits the use of computer programs both to balance chemical equations and to help students to use good strategies as they proceed. CHEMPROF, an intelligent tutor designed by the authors, is able to accept reactants and products from students and then to balance the resulting equation, both for redox and non-redox inorganic equations. This presentation will examine the issues of both development and pedagogy for balancing equations using a computer.

15E-6 IMAGES OF RESEARCH IN GENERAL CHEMISTRY. Jeffrey R. Appling, Department of Chemistry, Clemson University, Clemson, SC 29634-1905

Prototype computer programs are under development which aim to bring more and better images of chemistry research to students in the introductory courses. These tutorial/exploratory programs use animation and digitized video to help students connect basic principles learned in class to aspects of research activities pursued by Clemson faculty. It is hoped that exposure to better images of scientists will cultivate the interest of General Chemistry students and help them appreciate the role of chemistry research in modern science.

New Methods for Laboratory Testing, M. Cooper, Organizer *Thursday Morning*

29B-1 A GENERAL CHEMISTRY LABORATORY PROGRAM FOCUSSING ON "REAL WORLD" SUBSTANCES. Robert C. Kerber and Mohammad J. Akhtar, Dept. of Chemistry, SUNY at Stony Brook, Long Island NY 11794-3400.

Based on their experiences with high school and college introductory courses, many students perceive chemistry as a highly abstract, mathematical discipline dealing with atoms and molecules, but having little applicability to their lives. "Chemicals" are (1) manufactured, (2) unpronounceable, and (3) dangerous. In order to counter these kinds of pre- or misconceptions, we have introduced a new freshman laboratory program which deals entirely with household materials. Many lab courses nowadays incorporate exercises involving everyday materials; but we have attempted to focus the entire course on such materials, including household bleach, hydrogen peroxide, antifreeze, galvanized nails, inks, food coloring, fruit juices, soft drinks, aspirin, antacids, plastics, etc. Many of the exercises have been adapted from existing writeups; some have been created from scratch. We will describe our experiences, some of the new exercises we have introduced, and problems we have encountered. We will also summarize student reactions and future plans.

29B-2 CHEMISTRY GETS REAL. Christine M. Pharr, Steve D. Gammon, John D. Jegla and Barry J. Malmberg, Department of Chemistry, University of Idaho, Moscow, Idaho 83843.

"*Congratulations! You have just been awarded the position of Head Chemist for Heavy Metals, Inc. Your company has been hired to investigate heavy metal pollution in a popular trout fishing stream near Salmon, Idaho. Mining in the area has polluted the stream with so much cobalt that the water runs blue. The fish population in this stream is rapidly decreasing and heavy metals are the suspected cause. Your first contract requires you to determine the percentage of cobalt in water samples taken from this beautiful little stream.* This introduction is one of many possible scenarios available in a series of computer-assisted experiments being developed for student laboratories at the University of Idaho. These "inquiry" laboratory experiments are designed to allow students to use chemistry to solve real life problems. At the same time, they acquire the skills and chemistry content expected of a successful laboratory experience. Initial scenarios have been designed around spectrometry experiments which incorporate miniature photometers built from PVC pipe and interfaced to computers in the laboratory. Each scenario provides suggestions to help the students carry out their analysis. These suggestions lead to other preliminary experiments or tasks, which involve developing skills and using resources to solve their scenario in much the same way that real life chemists do analyses.

29B-3 THE ANALYTICAL PROCESS IN CHEMISTRY LAB. R. J. Eierman, Department of Chemistry, University of Wisconsin-Eau Claire, Eau Claire, WI, 54701.

A main purpose of chemistry teaching laboratory is to help students learn to solve problems using laboratory tools. Students must learn the tools and the process of using tools to solve specific problems. In quantitative and instrumental analysis students are taught the analytical process, but often don't get an opportunity to learn many of the steps besides the measurement of the analyte. Our instrumental analysis class is carrying out a variety of chemical analyses of groundwater samples collected by a UWEC Geology class from wells on campus. The students in the classes are being encouraged to communicate about their needs, problems, capabilities and limitations. Our class is trying to solve problems raised by the Geology class. We hope skills such as understanding the problems, communicating abilities and limitations both orally and in written form, time management, etc. will develop. In this talk I will report about our success (and failure) in teaching the entire analytical process.

29B-4 WHAT DID THIS GUY DO WRONG? David M. Whisnant, Department of Chemistry, Wofford College, Spartanburg, SC 29303-3663

To help improve the laboratory skills of our General Chemistry students, we have written a multimedia computer program that introduces common laboratory techniques, such as how to prepare solutions and how to do titrations. This ToolBook program, which is written for IBM-compatible PC's, uses Video for Windows sequences to illustrate the methods. The students are required to work through the program before an experiment in which they prepare their own solutions for use in a set of titrations. To encourage the students to think about the methods before they come to lab, the program includes four video sequences showing an instructor making many mistakes as he prepares solutions and does a titration. The students' assignment is to turn in a list of "what the guy did wrong." They are also asked to submit a stockroom request form for the equipment and chemicals they will need to do their experiment.

29B-5 **MACINTOSH COMPUTERS IN GENERAL CHEMISTRY LABORATORY**

Elizabeth Winter Wolpaw*, Jennifer Z. Gillies*, and Theresa A. Pardo+
Chemistry Department* and Academic Computing Services+, Siena College, Loudonville, NY 12211

The rapidly increasing use of computers in chemical research and industry requires that students gain computer experience throughout their undergraduate education. With funds from Siena College and NSF (Grant #USE-9250232), we have established a Macintosh computer facility adjacent to our General Chemistry laboratory and we have incorporated these computers into the laboratory curriculum. In our first-year lab, students use the Macintoshes for data analysis with spreadsheet and graphing programs (including pooled data from multiple lab sections), data retrieval from an index of spectral and physical properties, and data acquisition with interfaced probes. Our computer lab is open in the evening for out-of-class assignments and exploration of software used in upper-level courses. Our program is somewhat unusual in that we have coordinated computer use in chemistry with that in all of Siena's other science and math departments which decided together to commit to the Macintosh platform. Thus, skills gained in any of our courses can be applied across disciplines. Our entire chemistry lab curriculum is now structured to encompass increasingly sophisticated applications in upper-level chemistry courses.

29B-6 A Writing Intensive-Open Inquiry Physical Chemistry Lab
George R Long, Department of Chemistry, Indiana University of Pennsylvania, Indiana, PA 15705

Recently, there has been a movement in the education community to promote "writing across the curriculum". Consequently, the use of writing in the chemistry curriculum, in general , has received a great deal of attention. This presentation will discuss several aspects of adding writing to the laboratory curriculum, but will primarily focus on the use of writing assignments to enable students to direct their activities during an open laboratory format. This requires a shifting in the traditional emphasis of physical chemistry lab from the formal report to the laboratory notebook, and other writing assignments preliminary to the formal report. Also required is a shift too somewhat less technical rigorous experiments. This discussion will address some of these changes, as well as the structure of the course, an analysis of the students work, and the students evaluation of the course.

Innovative & Investigative Microscale Chemistry, M. Singh, Organizer *Thursday Morning*

30-1 THE MICROSCALE LABORATORY: INNOVATIVE EXPERIMENTS AND TECHNIQUES - AN UPDATE.
Ronald M.Pike, National Microscale Chemistry Center; Mono M. Singh and Zvi Szafran, Department of Chemistry, Merrimack College, No.Andover, MA 01845

Since the introduction of the modern form of microscale experiments and techniques began over a decade ago, the microscale method has penetrated all aspects of the introductory laboratories in the general, organic and inorganic areas at the college/university level. A large number of high schools and elementary schools are also enjoying the benefits of this approach. As time has passed, new innovative experiments have been developed and new techniques have expanded and enhanced the method. This presentation will discuss the impact of these new developments on the beneficial training of students. Such developments as a low cost pycnometer for density measurements, the solid phase extraction method, microscale titration, synthesis of photo chromic compounds, sonication activated reactions, microscale polymer preparations, and synthesis using electrolytic methods will be presented.

30-2 MICROWAVE MICROSCALE ORGANIC EXPERIMENTS. John W. Elder and Kathleen M. Holtz, Fairfield University, Fairfield, CT 06430

In the undergraduate organic laboratory, reactions performed in a commercial microwave oven have advantages over those done by conventional heating. Short reaction times avoid dead periods. The equipment is simple --- beakers and test tubes. Reaction mixtures are usually relatively free of byproducts and the workup simple. The dangers of flames, hotplates or hot sand baths are avoided. These reactions will be exemplified by condensations, reductions, polymerizations, esterifications and Diels-Alder, Cannizzaro and Williamson syntheses. Detailed procedures will be available.

30-3 INNOVATIVE MICROSCALE CHEMISTRY EXPERIMENTS FOR GENERAL AND ADVANCED GENERAL CHEMISTRY. M.M.Singh and Z. Szafran, Department of Chemistry and R.M. Pike, National Microscale Chemistry Center, Merrimack College, No.Andover, MA 01845

The chemistry department at Merrimack College has introduced microscale chemistry laboratory at all levels of the chemistry curriculum. As a part of our on-going research efforts in the area of microscale chemistry, we have recently developed a number of innovative experiments for the general and advanced general chemistry laboratory. In this presentation, we will discuss three such experiments. The first experiment involves the measurement of density of a liquid or a solution using a micropycnometer. The second experiment deals with the small scale synthesis of an organic compound by electrolysis. At the same time, this experiment can be used to verify Faraday's laws of electrolysis and to measure Avogadro's number. Finally, the third experiment uses micro-capillary mercury columns to study the gas laws. These microscale devices are constructed and used by the students during 3 hour laboratory period. The construction of these innovative devices, their uses in different experiments and the results obtained from these experiments will be discussed.

30-4 PHOTON-INITIATED HYDROGEN-CHLORINE REACTION: A VERSATILE AND EXCITING MICROSCALE EXPERIMENT. Leanne M. Egolf and Joseph T. Keiser, Department of Chemistry, The Pennsylvania State University, 152 Davey Laboratory, University Park, PA 16802

The photon-initiated hydrogen-chlorine reaction was originally presented as a dramatic "large-scale" lecture demonstration[1]. Using microscale technologies, a greatly simplified yet effective version of the prototype has been designed. Thus, capitalizing on both the safety and economic advantages afforded through small-scale techniques, we have been able to bring the chemistry into the hands of the student. This experiment can be used to teach a wide range of topics, including electrochemistry, thermochemistry, photochemistry, and kinetics. Or it can be used as a short, interesting, "gee whiz" experiment with a BANG at the end! Details will be presented.

1. Ramette, R. W. J. Chem. Educ. 1984, 61, 722-723.

30-5 MICROSCALE MULTISTEP SYNTHESIS OF A NOVEL HETEROCYCLIC COMPOUND. Rosemary Fowler, Department of Chemistry, Cottey College, Nevada, Missouri 64772.

A five-step synthesis of a "new" heterocyclic compound N-phenyl tetraphenylphthalimide has been developed. Tetraphenylcyclopentadienone serves as the key intermediate for the synthesis of N-phenyl tetraphenylphthalimide. The popular microscale synthesis of the diene, cyclopentadienone, is the initial step in the multistep synthesis of N-phenyl tetraphenylphthalimide. This reaction is followed by a Diels-Alder reaction, hydrolysis of an ester, formation of an anhydride, and an imide synthesis. The reaction times are short and the yields for the five reactions are good. Sufficient product is obtained in each step for the subsequent reaction and for spectral analysis of each compound. The proton NMR for N-phenyl tetraphenylphthalimide is unique and characterizes this novel heterocyclic compound.

30-6 MICROSCALE ELECTROPHILIC SUBSTITUTION OF P-TOLUIDINE, I. O. Kady, Department of Chemistry, East Tennessee State University, Johnson City, TN 37614

Although many organic chemistry laboratory textbooks deal with electrophilic aromatic substitution, only a few traditional experiments illustrate the principle of functional group protection, reactivity, and reaction orientation. In this paper we present microscale experiments which allow first-year organic chemistry students to apply group protection/deprotection and orientation of the nitration of disubstituted aromatic amines. These experiments incorporate common synthetic organic transformations such as direct nitration of unprotected p-toluidine to form the m-nitro derivative, acylation (protection) of the amino group of p-toluidine then nitration to form the o-nitro derivative, and hydrolysis of the acetamide group (deprotection) after the nitration is complete. Since all reactions proceed with good yields, a sufficient quantity of each product is obtained for spectral analysis and structure determination.

Contemporary & Affordable Physical Chemistry Experiments, E. Walters, Organizer *Thursday Morning*

35-1 THE P-CHEM LAB PROBLEM: THERE'S AN EASY SOLUTION -- AND IT'S WRONG. G. Dana Brabson, University of Virginia, Charlottesville, VA 22903.

H. L. Mencken commented that "There is always an easy solution to every human problem -- neat, plausible, and wrong." Consider the "reinvention" of the P-Chem lab. Syllabus: Is it time to replace many of the classic experiments that you and I cut our teeth on? Should there be a set of experiments common to all schools? What is the role of the P-Chem lab vis-a-vis Instrumental Analysis and other labs? Is P-Chem lab the place where students learn how to build up experiments? Should we put the emphasis on breadth of experience and understanding? or on depth? Structure: Should we insist on a thorough statistical analysis of the results? Are written documents still the best way to report results? Should students work by themselves? in pairs? in teams? How carefully should the experiments be laid out? how open ended? Literature Resources: Why do so many schools write their own experiments? Aren't current text books and manuals adequate? Where does the *Journal of Chemical Education* fit? Physical Resources: Can we afford the unique resources we need? Can we effectively use the resources distributed throughout the department? Is it acceptable to equip the P-Chem lab with second-hand equipment? What are the merits of cycling students through a piece of equipment currently engaged in cutting edge research? Do modern instruments look too much like black boxes? Is this an acceptable price for microprocessor controlled equipment? Personnel Resources: Do professors have time to develop experiments and interact with students in the labs? Are TAs qualified to teach the lab? What are the pluses and minuses of team teaching? I shall challenge you to evaluate your own situation in the context of these and related questions.

35-2 **GAS PHASE PHYSICAL CHEMISTRY EXPERIMENTS.**

Edward A. Walters, Department of Chemistry, University of New Mexico, Albuquerque, NM 87131.

A suite of gas phase experiments for advanced undergraduate laboratory courses will be described. The experiments are centered around an all-metal vacuum system assembled primarily from surplus components and designed to be flexible enough to allow incorporation of a number of experiments and methods representative of current practice in physical chemistry research. Mass spectrometry using a commercially available residual gas analyzer will be described in detail. This device is a microprocessor-controlled quadrupole mass spectrometer which mounts directly on the vacuum chamber. Experiments to measure isotope distribution in Xe, fragmentation of CF_3I and hydrocarbons, and the results of ion-molecule reactions will be presented. Other experiments based on the same vacuum chamber are the determination of quenching rate coefficients by laser induced fluorescence, resolved fluorescence spectrum of I_2, and pulsed molecular beam applications.

35-3 A COMBINED ADVANCED LABORATORY COURSE. Edward J. Miller, Kenneth W. Loach, Nicholas J. Mammano, Roger K. Sandwick, William E. Krueger, Chemistry Dept., SUNY College, Beaumont Hall, Plattsburgh, NY 12901.

We are moving to an integrated junior/senior undergraduate laboratory course offered over 4 semesters, replacing the traditional upper-level Inorganic, Organic, Physical, Biochemical and Analytical lab courses. (The traditional upper level courses are to be offered as theory lecture courses only.) In the first semester, the combined course mixes experimental assignments that require work in synthesis, qualitative and quantitative instrumental analysis, structural determination, kinetics, thermodynamics, enzyme and polymer chemistry. It is planned to have the first three semesters emphasize introduction to techniques and interpretation, with as much mixing of the traditional fields as possible, followed by a fourth semester centered around an undergraduate research project.

35-4 THERMODYNAMIC PROPERTIES OF AIR. Fred M. Homack, UNC-Wilmington, College Road, Wilmington, NC 28403. The well-known Clement-Decormes method for heat capacity ratio employs a large bottle of air, an oil manometer, and a rubber vacuum/pressure bulb. In that method, a rapid adiabatic expansion is followed by isochoric warming back to room temperatura. A novel interpretation is put forward in which the observed pressures are used to define the PVT states and the accurately known differences between them. Students are exposed to the concept of irreversible work, path independence of ΔE, and experimentally use the equation $\Delta E = Q + W$. Cv is directly calculated. Since air is diatomic and closely obeys the ideal gas law, the heat capacity and partial differential coefficients such as $(dV/dT)_8$ can be easily calculated and compared with experimental results.

35-5 CONDUCTIVITY, A SIMPLE METHOD TO PROBE MICELLAR SOLUTIONS, S. J. Bachofer, Chemistry Department, Saint Mary's College, Moraga, CA 94575

A physical chemistry experiment has been developed involving conductivity measurements to probe the fractional ionization (and thus the counterion binding) of a micellar aggregate. Students measure the specific conductivity of a salt and then study an ionic surfactant that forms micellar aggregates and has either the cation or anion of the salt as its counterion. The students determine the molar conductance at infinite dilution for the salt and utilize the obtained value along with specific conductance data for surfactant solutions at various concentrations to calculate the fractional ionization (counterion binding) using the Evan's method. Plotting the specific conductivity versus surfactant concentration allows the students to determine the critical micellization constant for the surfactant. A class of students can investigate the change in the chemical potential for micellization if various similar surfactants are studied with reliability. Students are introduced to counductivity measurements as a straightforward method to probe relatively complex chemical systems.

Conversation: Designing Laboratory Classrooms to Support Instructional Goals *Thursday Morning*
J. Phillips, Organizer

37-1 THE ACADEMIC LABORATORY - ENHANCING SAFE AND EFFECTIVE CHEMICAL EDUCATION, Joseph M. Phillips, Facility Planning, CUH2A, Inc., 211 Carnegie Center, Princeton, NJ 08540.

Chemical education and the conditions of teaching are changing rapidly; yet, academic laboratories have changed very little. This often creates a mismatch between the capacity and performance of the facility and the safe, effective housing of laboratory activities which support the chemistry curriculum and evolving educational conditions. In-depth analysis of the factors influencing chemical education - safety, new technologies, and changing curriculum and demographics - provides insight into laboratories which respond to the needs of chemical educators. Case studies of campuses, buildings and laboratories generate a discussion of facility problems and solutions, of techniques for acquiring access to the design process, and of strategic and tactical planning issues critical to chemical educators and to the performance of academic laboratories.

57E-1 BLURRING THE BOUNDARIES: UNDERGRADUATE CHEMISTRY EDUCATION IN THE NINETIES.

Nancy Devino, Michael Holden, Robert Leyon, Gerald Roper, and Cindy Samet. Department of Chemistry,Dickinson College, Carlisle, PA 17013-2896.

Dickinson College began an intense revision of its chemistry curriculum in Fall, 1991, and implemented the program in Fall, 1993. A major goal of our revised curriculum is to blur the boundaries found in traditional chemistry programs, in order to more accurately convey what chemists do and how they do it. First, our introductory workshop-style course, "BenchChem", eliminates the distinction between lecture and lab. A central element of this course is the use of instrumentation to transfer the emphasis of the laboratory to the interpretation of experimental results rather than the acquisition of data. To address the concern that general chemistry is not "about" anything, we selected a theme, "Chemical Transformations," for the course and delayed the teaching of material not related to this theme. Next, our intermediate and upper-level courses are designed to demonstrate the relationships between different subfields of chemistry. Synthesis and Reactivity I and II combine elements of both organic and inorganic chemistry. Equilibrium Systems will have features of our former Quantitative Analysis and Physical Chemistry I (thermodynamics) courses. A year-long, team-taught Integrated Lab course for junior chemistry majors will emphasize independent laboratory projects that incorporate concepts from more than one area of chemistry. Finally, we have introduced a research requirement into the chemistry major, to enable students to further integrate their theoretical knowledge and laboratory skills.

57E-2 A MORE FLEXIBLE CHEMISTRY CURRICULUM, Martin N. Ackermann, Department of Chemistry, Oberlin College, Oberlin, OH 44074

A new curriculum for chemistry and biochemistry majors will take effect this fall at Oberlin College. This curriculum will give chemistry majors considerable flexibility in how they choose to complete their major and will give biochemistry majors their first significant exposure to biochemistry in the sophomore year. All students will take a core set of courses consisting of a year of general chemistry and four one-semester courses, with laboratory, in analytical, inorganic, organic, and physical chemistry as well as a year of physics and mathematics through multivariate calculus. A key feature of this structure is the depth to which thermodynamics is introduced in the general course, followed by its use in subsequent courses in the core. Chemistry majors take at least nine additional credits from a wide selection of courses. Biochemistry majors complete bioorganic chemistry and and a biochemistry course which has two biology courses as prerequisites. The full set of courses to be offered and the structure of each major will be presented.

57E-3 THE NATURE OF THE CHEMICAL BOND STUDIED BY FT-IT SPECTROSCOPY: AN INTRODUCTORY CHEMISTRY LABORATORY EXPERIMENT USING COOPERATIVE LEARNING, Janet S. Anderson; David M. Hayes; T.C. Werner, Department of Chemistry, Union College, Schenectady, NY 12308.

We have developed an introductory chemistry laboratory experiment which makes use of IR(vibrational) spectroscopy to study several aspects of chemical bonding. First, students discover the connection between molecular vibration frequencies and bond strength and atom masses using simple 1-dimensional springs and weights. The nature of more complex molecular vibrations are illustrated by computer simulation of the normal modes. Students apply these results to FT-IR spectra they collect of a number of substances to "discover" multiple bonding, resonance, and hydrogen bonding. Students are divided into small groups, each of which do only a portion of the overall experiment. Results from all the groups are pooled at the end of the lab by having a representative from each group present their results and interpretation in a short seminar.

57E-4 NEW CURRICULUM MODEL USING COOPERATIVE LEARNING AND COMPUTERS IN ANALYTICAL CHEMISTRY COURSES. John C. Wright, Department of Chemistry, University of Wisconsin-Madison, 1101 University Avenue, Madison, WI 53706-1396.

The universal availability of modern spreadsheets has created new opportunities for teaching analytical chemistry in an authentic manner because students have sufficient computing power to describe complex chemical systems with the simple equilibrium concepts that are the foundation of the course. In order to accomplish this task, a cooperative learning environment has been created at Wisconsin where teams of students work on open-ended problems with well-defined goals. The students are responsible for designing, implementing, trouble-shooting, and analyzing the entire experiment. In order for this approach to work effectively, it is important to introduce a number of curriculum innovations that empower the individual students as well as the teams to accomplish significant work.

This work was supported by the National Science Foundation under grant 94-50615.

57E-5 UNDERGRADUATE RESEARCH AT THE INDUSTRIAL INTERFACE. Paul E. Beck, Department of Chemistry, Clarion University of PA, Clarion, PA 16214.

This paper will describe a very productive on-going research program at the academic-industrial interface between Clarion University and Kalama Chemical, Inc., Kalama, Washington, over the last five years. Their support has included: summer salaries for student researchers; compensation for faculty and support personnel; and purchases of supplies and chemicals. Kalama Chemical, Inc., the largest domestic supplier of benzoic acid, sodium benzoate, and salicylic acid, has developed a corporate objective of entering the flavors and fragrance market. In this presentation, I will discuss: the product line of Kalama Chemical, Inc.; and the contributions of Clarion University undergraduate students to Kalama's corporate objective. Specifically, I will discuss the research on coumarin, our contributions to the commercial success of benzyl acetate, and our current efforts to develop new synthetic methods of salicylaldehyde. Our successes and failures and our communication with management will be addressed. The advantages of this arrangement to the student researchers will be emphasized.

First-Year Chemistry Curriculum, P. L. Samuel, Organizer *Thursday Morning*

57F-1 THE INTRODUCTORY CHEMISTRY CURRICULUM: ALTERNATIVES AND INNOVATIONS. Lyman H. Rickard, Department of Chemistry, Millersville University, Millersville, PA 17551-0302.

Recent interest in reform of the introductory chemistry curriculum prompted the ACS Division of Chemical Education to form the Task Force on the General Chemistry Curriculum. The work of the Task Force is expected to result in alternative curricula to revitalize the introductory course by making it more current, relative and effective. One of these alternative curricula, the Core/Modular Curriculum will be described. The Core consists of the basic set of fundamental concepts and principles that all students completing introductory chemistry should know. The Core is then supplemented with modules which allow for more in depth study of topics selected by the instructor.

57F-2 NEW DIRECTIONS IN GENERAL CHEMISTRY. J. N. Spencer, Department of Chemistry, Franklin & Marshall College, Lancaster, PA 17604-3003.

Both the content and process of the general chemistry course are in question. Both have remained substantially unchanged for 30 years. New ways and some old ways of teaching certain aspects of the course will be presented. A consistent thematic approach to this course will be described.

57F-3 CHEMISTRY AND THE HUMAN ENVIRONMENT - A NEED-TO-KNOW APPROACH. Conrad N. Trumbore, Department of Chemistry and Biochemistry, University of Delaware, Newark, DE 19711

This one semester course for non science majors allows students to approve and reject subjects for study. Subjects which have nearly unanimous approval for retention in the course are, in order of presentation: greenhouse effect and global warming, ozone layer depletion, acid rain, energy from nuclear and fossil fuels, solar energy and energy conservation, air and water pollution, waste management and recycling, genes, DNA and diseases, and AIDS. Each subject allows the introduction of new chemical principles on a need-to-know basis. Nearly all the subjects in a traditional chemistry course are covered in this course. Extensive feedback, in-class testing, and small group participation in large classes help keep student interest level high. A textbook has been written specifically for the course and is currently being expanded for publication.

57F-4 THE UIC MATCH PROGRAM: A COMBINED MATH AND CHEMISTRY PREPARATORY CURRICULUM Donald J. Wink,* Sharon M. Fetzer, Sheila D. McNicholas Department of Chemistry and Department of Mathematics, Statistics, and Computer Science the University of Illinois at Chicago, Chicago, IL 60607

The chemistry and mathematics departments of the University of Illinois at Chicago are developing a common curriculum for preparatory instruction in general chemistry and intermediate algebra. The course, dubbed "The MATCH Program", is directed towards the large number of students who require such courses to succeed in college. The impetus for the curriculum comes from a recognition that such students, will likely do better if these courses are combined so that mathematics and chemistry instruction reinforce each other explicitly. Details of prior student performance that motivates this effort will be presented. Samples of course materials, including worksheets will be shown. The role of cooperative learning, team planning and teaching, and a future laboratory program will be discussed.

57F-6 USING "CHEMISTRY IN CONTEXT" IN COURSES FOR SCIENCE MAJORS

Arden P. Zipp, Chemistry Department, SUNY Cortland, Cortland,NY13045

The new ACS-sponsored text designed to be used in chemistry courses for nonmajors has also been used successfully in introductory courses for science majors, both as a supplement for a standard chemistry text and as a core text. The former technique will be described in this paper with an emphasis on the specific aspects that are especially useful for introducing topics normally covered in a typical introductory course. The philosophy and design of the CiC problem-based approach to teaching chemistry will also be discussed briefly along with the advantages of using this approach and student responses to it.

57F-7 A NEW INTRODUCTORY COURSE SEQUENCE FOR SCIENCE MAJORS BASED ON *CHEMISTRY IN CONTEXT*. Wilmer Stratton, Gerald Bakker, Jeffrey Hansen, and Paul Ogren, Department of Chemistry, Earlham College, Richmond, IN 47374

As the first step in a planned revision of our undergraduate chemistry curriculum, we are attempting a radically new approach to the introductory course sequence for our science majors. We are using the pedagogical philosophy of the new ACS-sponsored *Chemistry in Context* program, in which important societal questions are raised and the chemical principles are developed as needed. The first course is focused on the chemistry of the environment, with three major themes: atmospheric chemistry, aquatic chemistry, and energy. The second course is focused on organic and biochemistry. Both courses use *Chemistry in Context* as the primary text to provide the "story line", but this is supplemented with lectures and readings from other chemistry texts. For the latter, we are utilizing the customized printing services of Wm. C. Brown Publishers to provide students with selected chapters from appropriate texts. Relevant laboratory experiments are being developed for both courses.

In collaboration with the college Teaching Consultant, we are planning a longitudinal evaluation of the success of this approach and we are attempting to develop suitable test instruments.

57F-8 CHEMISTRY IN CONTEXT FOR SCIENCE MAJORS AT ANTIOCH COLLEGE. Stanley Bernstein. Department of Chemistry, Antioch College, Yellow Springs, Ohio 45387

The ACS sponsored program, *Chemistry in Context*, is a response to long-standing criticisms of the general chemistry course for non-science majors. Many of these criticisms also apply to the course for science majors, General Chemistry I. At Antioch we are using *Chemistry in Context* to revise this program. So far the revision has gone through two iterations. In our first attempt we used the first six chapters of the *Chemistry in Context* textbook and supplemented this with classroom materials taken from more standard general chemistry texts. In the second try we asked the publisher, Wm. C. Brown, to prepare for us a custom bound text containing the first six chapters of *Chemistry in Context* along with selected chapters from their more standard text, Kask & Rawn, *General Chemistry*. This was a change for the better. Other techniques that improved this course included having students work in small groups for certain classroom exercises and the laboratory (also taken from *Chemistry in Context*), and using open ended questions on take home exams. We have evaluated this approach by using student response as well as student performance in the second course in the sequence. One instructor teaching general Chemistry I for two quarters is probably insufficient to solve all of the problems. Thus this is a work in progress. Perhaps the biggest problem facing us is knowing how much content and what depth of coverage is required. Do we as professional chemists wish to continue the trends established over the past few decades in this regard?

Using History in Teaching Chemistry, P. L. Samuel, Organizer *Thursday Morning*

57G-1 SUCCESSFUL WOMEN IN SCIENCE. Martha R. Joseph, Department of Chemistry, Westminster College, New Wilmington, Pennsylvania 16172

While pursuing scientific careers women encounter obstacles that are different from those encountered by men. Discussions of the "leaking pipeline" and "glass ceiling" are currently found in numerous journals and news magazines. Historically there have been successful women scientists. Much can be learned by examining their accomplishments within the context of the scientific and cultural settings in which they lived and worked. Studying their successful methodology for surmounting the gender barriers they encountered provides information useful in dealing with this issue in our present society.

57G-2 WOMEN'S FIELDS OF CHEMISTRY: 1900-1920. M. F. Rayner-Canham and G. W. Rayner-Canham. Sir Wilfred Grenfell College, Corner Brook, NJ A2H 6P9, CANADA

It is still hard to encourage women into chemistry-related careers. To remedy the problem, we should examine the past, as in the early part of this century there was a significant proportion of women researchers in science. Three areas of chemistry seemed to be particularly attractive to women: atomic science, biochemistry, and crystallography. These fields has some common features that might explain their popularity and we will discuss them using quotes from the period. In our view, these factors are still important today. As well, possible reasons for the proportional decline in women's participation in science from the 1920s to the 1950s will be explored.

57G-3 MARIA EDGEWORTH: EIGHTEENTH CENTURY PIONEER OF CHEMICAL EDUCATION. Kate C. Scantlebury, Department of Chemistry and Biochemistry, University of Délaware, Newark, DE 19716.

Maria Edgeworth was an 18th century novelist, famous for her children's novels. However, in conjunction with her father, Richard Edgeworth, she wrote several treatises on education. Her book Practical Education includes essays on the teaching of chemistry and mechanics, as well as discussions outlining the importance of science education for girls. This paper will focus on Maria Edgeworth's educational theories and applications to chemistry education, her contribution to the field, and how her work could enrich the curriculum of a preservice science teacher education program.

57G-4 THE UNWELCOME DR. PRIESTLEY, J. E. WHITE, DEPARTMENT OF CHEMISTRY SOUTHERN ILLINOIS UNIVERSITY at EDWARDSVILLE, EDWARDSVILLE, IL 62026

After the Birmingham Riots, during which his home and possessions were destroyed, Joseph Priestley was subjected to a barrage of abuse, including threats to his life, that is hard to imagine today. There was some support, mostly from relatives and fellow Dissenters, but the prevailing attitudes in England and the specific focus on Priestley became intolerable. Quotations from contemporary letters and documents, some from a little-used source, will illustrate the visciousness of the attacks, even from churchmen, and will portray the hopelessness of the situation for him and his sons. Their decisions to emigrate to the United States seem to have been the only reasonable action.

57G-5 ANECDOTAL BIOGRAPHIES AND CARICATURES OF THE MEN AND WOMEN TAUGHT IN 1ST YEAR CHEMISTRY. Rose M. Robacker, 12 Crestmont, Newfoundland, PA 18445

This slide presentation is the result of research done in order to enable my students to learn more about the scientific process. I felt that if they knew about the men and women responsible for "chemistry", they would better understand how it all came about. It consists of 40 caricatures and anecdotal histories which enable one to see the person, and not just the work. It is in the hope that these will help the students, (and us teachers!) realize that these marvelous people are humans just like us--who, by their curiosity and hard, persistent work have given so much to mankind.

NOTES

Workshops

100. Pilgrimage to the Priestley House

Meet at the Bus Stop
The Joseph Priestley House will be designated a National Historical Chemical Landmark by the American Chemical Society on Monday, August 1, 1994. The nomination was made by the Susquehanna Valley Section and the Division of Chemical Education; the ceremony is being planned by the Susquehanna Valley Section. The Joseph Priestley House is administered by the Pennsylvania Historical and Museum Commission.

Celebrate the 200th anniversary of the emigration of Joseph Priestley to America, and the 220th anniversary of the discovery of oxygen. Visit the American home of Joseph Priestley in Northumberland, PA. Enjoy a special museum exhibit "Joseph Priestley's American Legacy" at the Lore Degenstein Gallery, Susquehanna University, a joint exhibit with the Trout Gallery of Dickinson College. ($7)

101. Chemistry in Context. Learn about the goals, philosophy and unique features of this innovative approach to the non-major college chemistry course. Experience the decision making activities, effective teaching methods, and laboratory experiments designed specifically for this college level course. Not open to high school teachers. Robert Silberman, State University of New York College at Cortland, with Wilmer Stratton, Earlham College; Diane M. Bunce, Catholic University of America; A. Truman Schwartz, Macalester College; Conrad Stanitski, University of Central Arkansas; and Arden Zipp, State University of New York College at Cortland ($15) Participants must bring safety glasses

102. The PSI-PET Physical Science Course for Prospective Elementary Teachers. For teachers of physical science courses or elementary education majors, participants will examine materials that relate to "The Nature of Matter" section of an NSF sponsored joint AIP-AAPT project. Dorothy Gabel, School of Education, Indiana University ($15) Participants must bring safety glasses

103. ChemSource: The Pre-Service Guide and Usage of Videotapes and Laser Disks.
Description of SourceView and ChemSource GuideBook and their potential as aids to pre-service teachers, their instructors and cooperating teachers in the schools. Mary Virginia Orna, College of New Rochelle; Dorothy Gabel, Indiana University; M. Lynn James, University of Northern Colorado
($15)

104. ChemSource: SourceBook Laboratory Activities. The use of hands-on activities to promote higher-order thinking using the SourceBook component of ChemSource. Jean Delfiner, Bronx High Schools; Mary Virginia Orna, College of New Rochelle; James Schreck, University of Northern Colorado; Marie Sherman, Ursuline Academy ($25)

105. An Introduction to ChemSource and SourceBook on CD-ROM. Learn to use HyperCard stacks to electronically access the complete SourceBook on CD-ROM. Hands-on use of the materials. John Gelder, Oklahoma State University($5 without software, $55 including the CD-ROM Disks)

106. Safety in the Laboratory - The Chemical Hygiene Plan.
Safety in the typical chemistry instructional laboratory will be reviewed using OSHA mandated Chemical Hygiene Plan as the vehicle. The new ACS CHP program will be demonstrated and a copy will be given to each registrant. Specify MS-DOS or Macintosh format. George Wahl, North Carolina State University; W. H. Breazeale, Jr., Francis Marion University.
($25)

107. Small Scale and Doing Chemistry Experiments on CD-ROM
Learn to use computer searching to access experiments from a CD-ROM which display movies and organizes procedures for 200 experiments. Learn how to edit and save the instructions for the experiment from the CD-ROM onto a hard drive for future use. A complete set of data is available for many experiments in a format designed to be used by students to make up occasional laboratory absences. Teachers will see how to use one of these experiments with students. Programs will be commercially available. Helen B. Brooks, Synaps

108. SIRs, Smart Instructor's Resources for the IBM. Make your lectures interactive! Using SIRs you can simulate chemical systems and together with your class ask "What would happen if....?" with the computer program providing a graphical response. Classroom use requires a PC with VGA graphics and a mouse, as well as projection facilities. Programs will be published by JCE: Software as "Simulations: Interactive, Responsive." John S. Martin, University of Alberta($5 or $80 including JCE software)

109. How to Make CAI Make a Difference. Computer Aided Instruction can fundamentally alter what students learn and how they learn it...or it can have almost no effect at all. Discussion includes how to integrate CAI into a course and some of the pitfalls. See how CAI can be used for exposition, remediation, and problem-tutorial instruction. Program will be commercially available. Stephen K. Lower, Simon Fraser University

110. Computation in the Undergraduate Curriculum. Computation may be used to complement both lecture and laboratory experiments in the undergraduate curriculum. Structure and molecular properties are easily computed and graphical models facilitate learning. Software is commercially available. Warren Hehre, Wavefuntion, Inc.

111. Demonstrations in Chemistry: For the Love of Science and Sciencing. Perform, observe and discuss more than 40 experiments designed to interest, motivate, question and challenge. The Workshop Kit includes some of the special materials necessary to repeat the experiments in your own classroom. Included are seven new quantitative gas law experiments which do not require mercury. Directions and recipes, safety information and evaluation processes are discussed. Irwin Talesnick, Queen's University ($85) Participants should bring safety goggles

112. Hey..If I Can Do It, You Can Do It! Practical Tips for Doing Hands-On Science with Elementary School Students! Designed for chemists interested in, but apprehensive about, contributing to the science experience of elementary school students. Activities which are adaptable for grades K-? include: chromatography kids can wear, diaper absorbency testing, making and understanding slimes, acid/base indicators, candle and food chemistry. John S. Phillips, Wilkes University ($30) Participants must bring safety glasses

113. Hands-on Polymer Experiments and Demonstrations. Join the Polymer Ambassadors in doing many unusual hands-on polymer activities and demonstrations. Suitable for middle, junior and senior high school science classes, these experiments are safe and economical. Marie C. Sherman, Ursuline Academy ($15)

114. Chemistry in Microscale: Advanced Microscale Experiments for Advanced Placement Chemistry and First Year University Chemistry. For teachers of second year HS or introductory college chemistry currently using microscale experiments, participants will do six experiments from "Chemistry in Microscale" published by Kendall/Hunt and other sources and include kinetics, heats of neutralization, equilibrium, electrochemistry and boiling point determinations. John J. Mauch, Pasco School District No 1, Pasco, WA. ($55) Participants must bring their own safety goggles and lab apron

115. Chemistry in Microscale: An Introduction to Microscale Experiments. John J. Mauch. For teachers with limited microscale experience, participants will do experiments from "Chemistry in Microscale" published by Kendall/Hunt, such as generation of H_2 and O_2, electrolysis of KI and triple point of CO_2. John J. Mauch, Pasco School District No 1, Pasco, WA. ($55) Participants must bring their own safety goggles and lab apron

116. Microscale Chemistry in General and Inorganic Chemistry and How to Implement it. Learn to make and use micro-scale equipment for density, boiling points, distillation, burets, columns, crystallization and filtration. Perform several hands-on experiments. Discussion will include how to convert to microscale without major expense and recycling procedures. Two sessions will be offered: one for General Chemistry and one for Inorganic Chemistry. Mono Singh, Merrimack College ($15) Participants must bring their own safety goggles

117. Computer Tutorial: IR TUTOR, An Animated Approach to Spectroscopy in the Classroom and Laboratory. Strongly recommended for participants in the "Modern Methods of IR Spectroscopy" workshop. Open to others as well. Lenny Fine, Columbia University

118. Modern Methods of IR Spectroscopy. The use of FTIR in teaching vibrational spectroscopy, with special emphasis on new teaching methods for spectral interpretation in the classroom and laboratory. Hands-on activities for both novice and experienced users of FTIR. Lenny Fine, Columbia University
($30)

119. FTNMR Simulations on the IBM PC. Programs that simulate FTNMR, APT, DEPT, INEPT, 2d-HETCOR, Heteronuclear 2d J-Resolved, and Homonuclear 2d J-Resolved NMR will be made available to workshop participants. The workshop will be devoted to a discussion of how the programs work, and how they can be used in a classroom or laboratory to greatly simplify teaching and learning FTNMR. H. M. Bell, Virginia Polytechnic Institute and State University ($10)

120. Superconductors, Semiconductors, and Metals: Bring Solids into Introductory Chemistry Courses. Virtually every topic in introductory chemistry courses can be illustrated with solids. This workshop will show how high-tech solids naturally complement traditional molecular examples of chemical principles. Hands-on demonstrations and laboratory experiments will be taken from the book "Teaching General Chemistry: A Materials Science Companion." Arthur B. Ellis and Laura Wright, University of Wisconsin-Madison and George C. Lisensky, Beloit College ($35or $10 without the book) Participants need to bring safety glasses

121. Introduction to Optoelectronics. Learn how chemistry can be used to explain the behavior of devices which form the building blocks for the exciting field of optoelectronics. Two types of devices will be investigated: those which emit light (light emitting diodes or LEDs) and those which detect light (photodiodes). Hands-on laboratory experiments and devices you can take home will be included. Susan Lord, Electrical Engineering, Bucknell University ($15)

122. Strength of Materials. A tension test will be performed to determine a metal's strength and stiffness, and demonstrate inelastic behavior, deformation, and ductile fracture. James Orbison, Civil Engineering, Bucknell University

123. Essay Writing in Chemistry Classes. Discussion includes the reasons for assigning essays in chemistry classes, what students can learn, what teachers can learn about students, and evaluation of student essays. Herbert Beall, Worcester Polytechnic Institute ($5)

124. Introducing Students to Chemical Information Sources. Designed for college chemistry teachers, this workshop will discuss sources for curricular material, instructional formats (separate course vs. a few lectures plus exercises), teaching on-line searches at lower costs, and how to initiate an on-line program at your institution. Maggie Johnson, Chemistry/Physics Library, University of Kentucky and Adrienne Koslowsky, Central Connecticut State ($25)

125. Search CAS On-Line. Basics of on-line searching for CAS. Bob Zuzak, STN ($5)

126. Search CAS On-Line by Structure. Substructure Searching (Call STN at 1-800-848-6538 to register for this special 6-hour workshop, academic price $110). Thursday, Aug. 4, 9 - 4 pm

127. Research In Chemistry Education. Learn about the empirical, theoretical and philosophical literature in chemistry education. Investigate data collection and analysis methods used in chemistry education. Participants will be required to prepare and submit to the workshop leader, by mid June, 3 to 5 questions of interest and references for 5 to 7 articles related to those questions. During the workshop, groups of participants will develop a research plan to pursue following the conference. Craig Bowen, University of Washington

128. ACS Satellite Television Seminar *Teaching Chemistry, 1994*. See the videotaping of portions of the ACS Satellite Television Seminar *Teaching Chemistry ,1994* to be broadcast during National Chemistry Week. *Teaching Chemistry* features prominent chemical educators from a wide range of teaching environments demonstrating their techniques. Each participant will receive a discount certificate to view the live program in November at a local site where they will receive a copy of the course book. Michael Shea, American Chemical Society

129. Sliming, Floating, Glowing, Sinking-Teaching Science With TOYS on the Road. Perform, observe, discuss and take part in chemistry activities developed as part of Miami University's Teaching Science with TOYS program. Use both home-made and purchased toys to explore basic chemistry concepts in your classes or in outreach programs. Mickey Sarquis, Miami University; John Williams; Lynn Hogue; Jerry Sarquis and Nancy Grim ($50) Participants must bring safety glasses.

130. Chemistry Demystified. Many chemical principles can be observed and illustrated using safe household chemicals. Participants will do safe and simple "experiments" which could be done at home or in the dorm. Discussion of the experiments and ideas for additional exercises. T. R. Dickson, Cabrillo College

131. Keeping Your Apple in Use. Investigate the use of AppChart, a combination of hardware and software for the Apple series (II+ and IIe) which significantly extends the capabilities of the chemical instrumentation commonly found in high schools, such as pH meters, Spectronic 21 and Gow-Mac GC. Commercial Workshop. Tom Fisher, Inexpensive Systems

132. Chemistry is for Everyone. In this hands-on chemistry workshop, participants will use common household substances to do activities suitable for K-12 students. The activities will mainly come from the Institute for Chemical Education's Guidebooks entitled "Fun with Chemistry." Al Hazari, University of Tennessee, Knoxville

133. Ideas for How High School Students Can Enhance the Elementary Science Classroom. Perform experiments designed by high school teachers and used by their students with younger students. Discuss how to develop such a program with your students. Michelle Anderson, Juniata College ChemVan Program

134. A Model System for Teaching Structure, Bonding and Hybridization. Get hands-on experience with a patented interactive model system, VSPR FLEX^{TM}. Harold Teague, Pembroke State University

135. Polymers: A Vehicle of Instruction. Topics presented in Physical Science, Chemistry or Physics courses can be illustrated with examples from industrial applications of polymers: participants will have hands-on use of materials. Ways of involving students with mentors from local industries will be discussed. The program is sponsored by the Intersocietal Polymer Education Task Force, the Ohio Academy of Science and the Polymer Ambassador of Ohio. Melanie R. Stewart, Stow Munroe Falls High School

136. Chemistry with Computers. This demonstration of the use of computer interfaced devices to enhance laboratory experiments includes temperature probes, voltage input, conductivity probes, pH probes, pressure sensors and colorimeters. Experiments are from the laboratory manual *Chemistry with Computers* All experiments can be performed using Macintosh, IBM or Apple II computers with Vernier hardware and software. Commercial Workshop Donald L. Volz, Mannheim American High School and Dan D. Holmquist, Vernier Software

137. Numerical Methods in Physical Chemistry Using MATHCAD. MATHCAD™ software allows equations to be written as they would in a mathematics reference book and it is an aid in manipulation of formulas, numbers, texts and graphs. The introductory lecture will discuss its use in teaching Physical Chemistry. The hands-on session (using the Mac version, IBM is similar) will allow users to manipulate data for themselves. A number of templates will be provided on a disk to participants. Sidney Young, University of South Alabama ($10)

138. User Friendly Instrumentation for High School Chemistry Classes. Perform several laboratory experiments using instrumentation: gas chromatographs, UV and IR spectrophotometers, pH meters, nuclear scalers and microscale techniques. Michelle Anderson, Juniata College ChemVan Program

139. Advanced Labs for Second Year High School Chemistry Students. Perform several laboratory experiments developed by high school chemistry teachers using instrumentation. Michelle Anderson, Juniata College ChemVan Program

140 Laboratory Safety. Review the fundamentals of laboratory safety and learn to develop a laboratory safety program for your school. Topics include: accidents, liability and legal aspects, eye and face protection, handling, storing and disposing of chemicals, biological and animal hazards and planning for emergencies. James A. Kaufman, The Laboratory Safety Workshop ($95)

141. Laboratory Safety Program. This lecture will discuss The Simplest, Least Expensive, Most Effective Lab Safety Program and the critical role of supervisors and department heads in safety leadership. James A. Kaufman, The Laboratory Safety Workshop

142. PC Based Molecular Modeling Dynamics. Get hands-on use of software packages for molecular design and manipulation. Use an Artificial Intelligence based formulation package. Discuss the role of such programs in your curriculum. Commercial Workshop. Arthur B. Williams and Associates

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INDEX

To use this index, find the author. The first column gives the day and approximate time, for example:

MM for Monday Morning
TE for Tuesday Evening
WA for Wednesday Afternoon
RN for Thursday Noon

XX-D for Demonstrations
XX-B for Birds-of-a-Feather

The second column gives the abstract number, for example: 15B - 1 indicates session 15, section B, paper 1.

The abstracts are presented after the introductory letters, in the following order:

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Birds-of-a-Feather Sessions
Symposia
Workshops

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To use this index, find the author. The first column gives the day and approximate time, for example:

MM for Monday Morning
TE for Tuesday Evening
WA for Wednesday Afternoon
RN for Thursday Noon

XX-D for Demonstrations
XX-B for Birds-of-a-Feather

The second column gives the abstract number, for example: 15B - 1 indicates session 15, section B, paper 1.

The abstracts are presented after the introductory letters, in the following order:

Demonstrations
Birds-of-a-Feather Sessions
Symposia
Workshops

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Ron Perkins, Chair-Elect
Michaeleen Lee & Rudolph Jones
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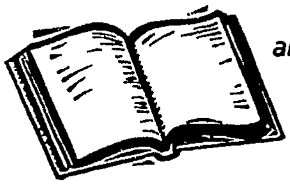

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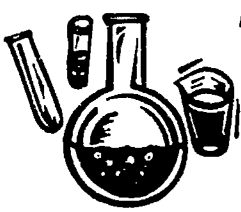

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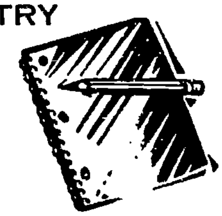

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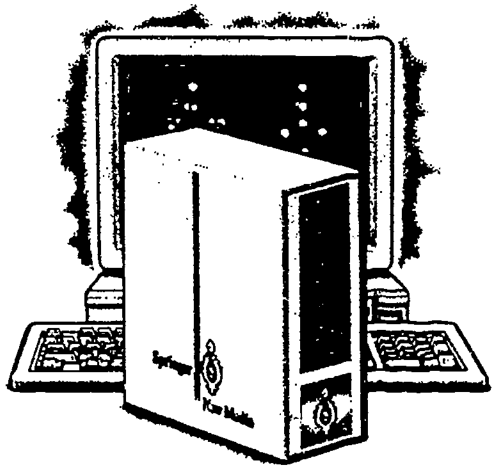

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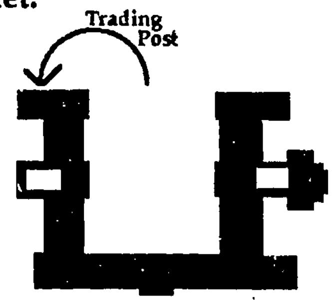


The Bucknell Biology Department invites you to tour the Green House, on the 4th Floor of the Biology Building.

The Green House boasts 3200 square feet of growing area divided into a living museum and state-of-the-art research area.

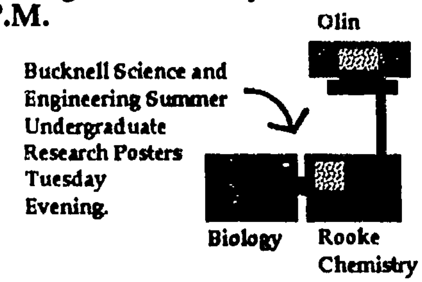
The living museum contains a desert area, bog, pond, tropical rain forest, and economic plant displays.

Guided Tours: Monday and Tuesday

9:30 - 11:00 A.M. and 4:00 - 6:00 P.M.

The Bucknell Chapter of Sigma Xi invites you to come see the work of students in the 1994 Summer Reseach Program.

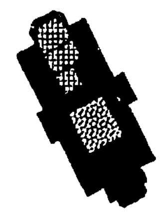
Posters and students will be available in the attrium and hall ways of Rooke Chemistry, and the Biology Building on Tuesday evening, 7:30 - 9:00 P.M.



Places to go for a bit of quiet:

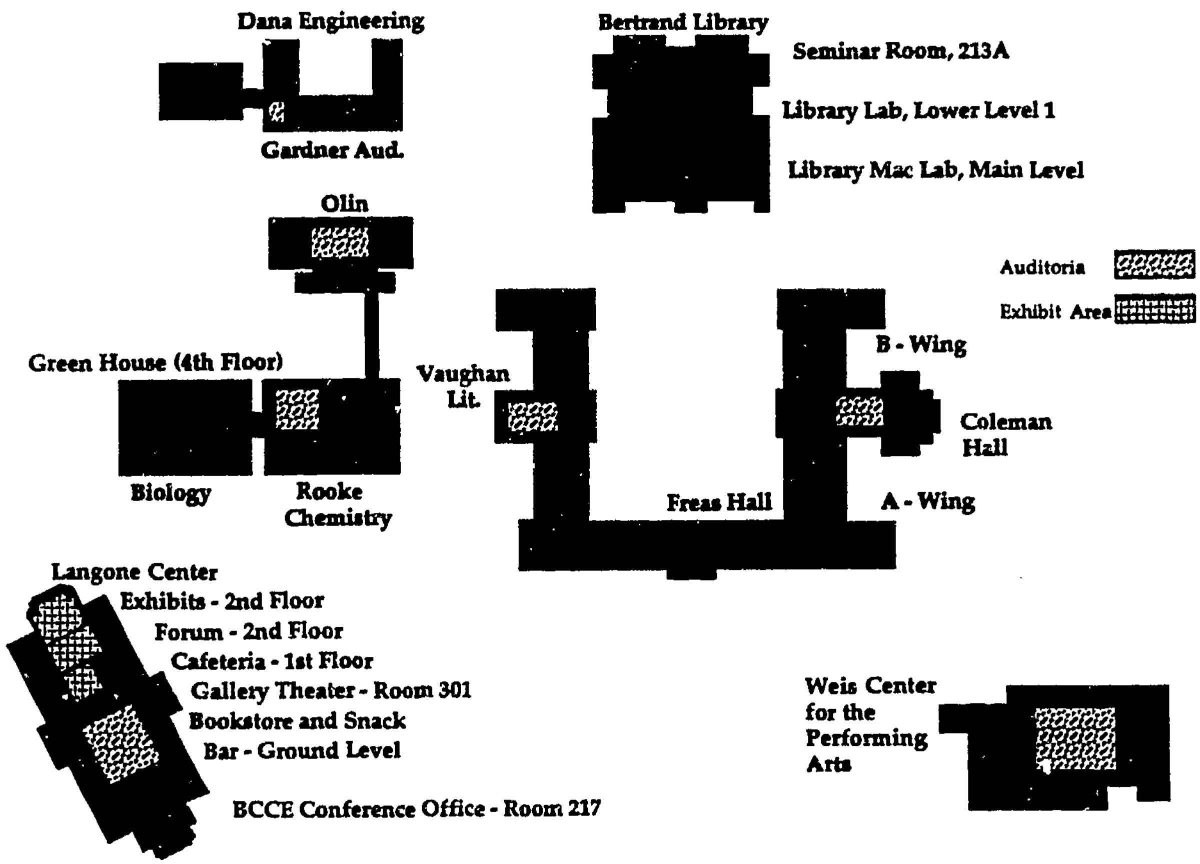
Bertrand Library - Do go see this beautiful building. There are five floors, two of which are below ground. Natural light is found making its way even into the second lower level.

Langone Center - Visit the Art Gallery and Arches Lounge on the third floor, or Walls Lounge on the second floor, just past the conference office, Langone 217.



NOTES

Sunday At-A-Glance



Time	Weis Center	Bio 5	Bio Lab 112-114	Rooke 102, 107-110	Rooke 9 Mac Lab	Bus Stop Weis Center
8			115 Chemistry in Microscale: An Introduction to Microscale Experiments.	111 Demonstrations in Chemistry: For the Love of Science and Sciencing		
9		128 ACS Satellite Television Seminar: Teaching Chemistry				
1			114 Chemistry in Microscale: Advanced Microscale	111 Demonstrations in Chemistry (Continued)	105 An Introduction to ChemSource and SourceBook on CD-ROM	
2		128 ACS Satellite Television Seminar: Teaching Chemistry				100 Priestley House Pilgrimage
8	Keynote Address					

Monday At-A-Glance

Time	Weis Center	Bus Stop Weis Center	Coleman 101B	Rooke Aud. Room 116	Vaughan Lit. Aud.	Forum, Langone Center	Dana 132 Gardner Aud.	Olin Aud.
8	Plenary Address							
10	1 Of Mice and Men and the Isolation of Oxygen		4A Chemical Research Opportunities for Secondary School Faculty	17A Computers in High School and General Chemistry	41A Teaching My Favorite Topic	42A A Single Coherent Picture of the Bond?	54 Technicians and Technician Education: Becoming Mainstream?	117 IR TUTOR: An Animated Approach
2	100 Joseph Priestley House Designation Ceremony (Rain Location)	100 Joseph Priestley House Designation Ceremony At the Priestley House in Northumberland.	4B Chemical Research Opportunities for Secondary School Faculty	136 Chemistry with Computers	41B Teaching My Favorite Topic	17B Computers in Organic & Analytical Courses	42B A Single Coherent Picture of the Bond?	24 Environmental Chemistry & Environmental Science Programs
4	Chemical Demos							
6				136 Chemistry with Computers				
7		100 Priestley House Pilgrimage and 2YC3 Reception						Chemical Demos

Monday

Time	Bio Lab 102 & 105	Bio Lab 106	Bio Lab 115	Rooke 17, IBM Lab	Rooke 102 & 107	Bio 5	Langone 302
10	101 Chemistry in Context	102 PSI-PET	104 ChemSource: SourceBook Lab Activities	108 SIRs, Smart Instructor's Resources for the IBM.	111 Demonstrations in Chemistry: For the Love of Science and Sciencing.	128 ACS Satellite Television Seminar	
2			104 ChemSource: SourceBook Lab Activities		111 Demonstrations in Chemistry: For the Love of Science and Sciencing Continued	128 ACS Satellite Television Seminar	110 Computation in the Curriculum, Hands-on session

Monday

Monday At-A-Glance

Time	Coleman Theater	Coleman 103B	Coleman 102A	Coleman 101A	Coleman 202A	Coleman 1A	Langone Center Gallery Theater
9	38A Increasing the Use of Writing in Chemistry Courses						
9:30							110 Computation in the UG Curriculum. Introductory Lecture.
1	26 Moving Mountains: Changing the Teaching of Chemistry at Large Universities	38B Increasing the Use of Writing in Chemistry Courses	46 Conversation: Is the ACS Approved Curriculum Outdated?	20 What Will "Textbook" Mean in the Year 2000?	40 The Non-Traditional Student	57A Laboratory Teaching Coleman 1A	
2							109 How to Make CAI Make a Difference.
6	Posters: Rooke Chemistry Building Atrium and Basement				Posters: Larison Dining Hall		
7:30	3 Undergraduate Research	44 Is There an Ideal Periodic Table?	15A Computer Applications	34 Problem Solving in Organic Laboratory	58A Laboratory Teaching	58B Teaching Organic Chemistry	
9:30					Social in Bostwick Dining Hall		

Time	Rooke 9 Mac Lab	Olin Lab 261	Dana 227 IBM Lab	Library Lab, Lower Level 1	Bio Lab 112 & 114	Bio Lab 112	Freas Hall, University Lounge	Bio Green House
9:30				124 Introducing Students to Chemical Information Sources.				
11								Tours
12							BOF Textbook Authors Association	
1:30	105 An Introduction to ChemSource and SourceBook on CD-ROM	142 PC Based Molecular Modeling	119 FTNMR Simulations on the IBM PC.		115 Chemistry in Microscale: An Introduction to Microscale Experiments.	112 Hey..If I Can Do It, You Can Do It! Practical Tips for Doing Science with Elementary School Students!		
3								Tours

Tuesday At-A-Glance

	Weis Center	Langone Gallery Theater Room 301	Coleman Theater	Langone Center, Forum	Olin Aud.	Vaughan Lit. Aud.	Rooke Aud. Room 116
8	Plenary Address						
9							106 Safety in the Laboratory The Chemical Hygiene Plan.
10	21A Molecular Visualization: From PC/Mac to Workstation Environment	8 National Initiatives & Affect the on Teaching	18 How Things Work: The Chemistry of Technological Devices	23A Responsible Environmentalism/ Environmentally Responsible	27A TA Training: Solutions to Knotty Problems	31A Innovative Uses of Modern Instrumentation in Intro. Courses	
11							
12							
1							
2	21B Molecular Visualization: PC/Mac to Workstation	48A New Approaches to Teaching Organic Chemistry Center	38C Increasing the Use of Writing in Chemistry Courses	23B Responsible Environmentalism/ Environmentally Responsible	52 What Is Chemical Education Research?	31B Innovative Uses of Modern Instrumentation in Intro. Courses	
3							
4	Chemical Demos						
5							
6							
7							107 Small Scale
8			Brasted Memorial Lecture		32 Interfacing Instrumentation in Adv. Labs		15B Computers in the Classroom & Laboratory
9							
10							

Tuesday

	Coleman 1A	Vaughan 103	Coleman 103B	Coleman 101A	Coleman 202A	Dana 132 Gardner Aud.	Coleman 102A	University Lounge, Freas Hall
8								
9						123 Essay Writing in Chemistry Classes.		
10								
11								
12	BOF Chemistry in Context		BOF Project Totem	BOF -Committee on Computers in Chem. Ed.				BOF- Chemical Reform and the Chemical World
1	6 Van Programs: Instrumentation on the Road to High Schools	7 Conversation: Coping with a Dual Assignment	28A Nurturing Chemistry Majors at Large Universities	50 Geochemistry in the Classroom	57B Teacher Education and the High School Curriculum	57C Teaching Tips	59-3,1,6 More Tips and Resources	
2								
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Tuesday

Tuesday At-A-Glance

	Bus Stop Weis Center	Dana 307	Rooke 17 IBM Lab	Langone 302	Olin 274	Dana 227 IBM Lab	Library Mac Lab	Olin Lab 261
8								
9	100 Priestley House Pilgrimage		108 Smart Instructors Resources SIRs		118 Modern Methods of IR Spectroscopy.	119 FTNMR Simulations on the IBM PC.	125 Search CAS On-Line. The Basics.	142 PC Based Molecular Modeling
10		103 ChemSource: Guide,Video and Laser Disks.		110 Computation in the Curriculum, hands-on session				
11								
12								
1	100 Priestley House Pilgrimage		106 Hygiene Plan (con'd) IBM Hands On	110 Computation in the Curriculum, hands-on session	118 Modern Methods of IR Spectroscopy.		125 Search CAS On-Line. The Basics.	
2		103 ChemSource: Guide,Video and Laser Disks.						
3								
4								
5				Larison Dining Hall		Bio 115		Rooke Attrium
6								
7				58C Posters: General		22 Environment ally Friendly Laboratory Experiments	Bucknell Summer Research: Science and Engineering Posters	
8								
9		Social in Bostwick Dining Hall						
10								

Tuesday

	Rooke 9 Mac Lab	Coleman B2 Mac Lab	Rooke 335 Organic Lab	Dana 347 EE Lab	Bio Lab 108	Bio Lab 110	Bio 5	Coleman 1B	Bio Green House
8									
9					129 Teaching Science With TOYS on the Road.				
10									
11									
12								BOF New Kid on the Block	Tours
1	105 An Introduction to ChemSource and SourceBook on CD-ROM	106 Hygiene Plan (continued) Mac Hands On	116 Microscale in Inorganic Chemistry	121 Introduction to Opto-electronics.		132 Chemistry is for Everyone.			
2									
3							141 Laboratory Safety Program.		Tours
4									
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6									
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9									
10									

Tuesday

Wednesday At-A-Glance

Time	Weis Center	Langone Center Forum	Coleman Theater	Rooke Aud. Room 116	Olin Aud.	Langone Gallery Theater	Bio 5	Vaughan Lit. Aud.
8–9	Plenary Address							
10–12		9A Innovative Teacher Education Programs	13A Transforming the Chem. Learning Environment	15C Computer Applications in the Class & the Lab	27B TA Training: Solutions to Knotty Problems	28B Nurturing Chem. Majors at Large Universities	49A Lasers in the Undergrad. Curriculum	53 Teaching & Assessment of Higher Order Cognitive Skills
2–4		29A New Methods for Laboratory Teaching	47 Teaching and Evaluation of Critical Thinking	15D Computer Applications in the Class and Lab	13B Transform the Chem. Learning Environment	55 Is an Associate Degree Detrimental to the Future?	49B Lasers in the Undergrad. Curriculum	
4–5	60-8 Chemical Demonstrations							
6–8			Conference Banquet					
9–10			Ice Cream Social in Bostwick Dining Hall					

Wednesday

Time	Bio Lab 115	Bio 104	Coleman 101 B	Coleman 102 A	Coleman 204 A	Dana 132 Gardner Aud.	Coleman 203 B	Library Seminar 213 A	Freas Hall University Lounge
9:30–12	138 Instruments (High School Chemistry)	140 Lab Safety							
12–1				BOF HS and College					BOF HS Chem. Committee
1–3	139 Adv. Labs for 2nd Yr. High School Chem.								
1:30–4		140 Lab Safety	9B Innovative Teacher Education Programs	10 The Role of A.P. Chem. in the 3rd Millennium	12 How is Chem. Useful for Engineers?	19 New Directions in Inorganic Chemistry	36 Incorporating Biochem. into Chem. & Bio. Curricula	39 New Info. Technologies for Chem. Ed.	BOF Business Meeting: HS Chem. Committee
3–5	133 HS Students Enhance Elem. Science								

Wednesday

Wednesday At-A-Glance

Time	Bus Stop Weis Center	Bio 102 & 105	Langone 302	Olin Lab 274	Olin Lab 271	Bio Lab 108	Olin Lab 261	Bio Lab 110	Rooke 18 Case Room
Morning (9–12)	100 Priestley House Pilgrimage	101 Chemistry in Context	110 Computation in the Curriculum	118 Modern Methods of IR Spectroscopy	120 Super-conductors, etc.	130 Chemistry Demystified	131 Keeping Your Apple in Use	134 Model System; 134 Model System	137 Numerical Methods (MATHCAD)
Afternoon (1–5)	100 Priestley House Pilgrimage		110 Computation in the Curriculum	118 Modern Methods of IR Spectroscopy	120 Super-conductors, etc.		131 Keeping Your Apple in Use; 131 Keeping Your Apple in Use		

Wednesday

Time	Coleman 202 A	Coleman 103 B	Coleman 203 A	Coleman 1 A	Bio Lab 112-114	Rooke Organic Lab 335	Bio 101	Rooke 9 Mac Lab	Library Lab Lower Level 1	Coleman 1B
Morning (10–12)									BOF Intro STN-CAS; BOF Open STN-CAS	
Noon (12–1)				BOF Org. Texts						BOF Un-Confusing Thermo
Afternoon (1–5)	45 Using Models in Chemistry Teaching	48B Approaches to Organic Chemistry	57D Research in Education (Examples)	59-4,5,2 More Tips and Resources	114 Chemistry in Microscale	116 Microscale in General Chemistry	135 Polymers: A Vehicle of Instruction	137 Numerical Methods in Physical Chemistry Using MATHCAD	BOF Intro STN-CAS; BOF Open STN-CAS	

Wednesday

Thursday At-A-Glance

Time	Weis Center	Olin Aud.	Coleman 103B	Rooke Aud.	Coleman Theater	Dana 132, Gardner Aud.	Coleman 101A	Coleman 102A
8–9	Plenary Address							
10–12		13C Transforming the Chemistry Learning Environment	14 Computers in the Classroom: A Basis from Research and Assessment	15E Computer Applications in the Classroom & Laboratory	29B New Methods for Laboratory Teaching	30 Innovative & Investigative Microscale Chemistry	35 Contemporary & Affordable Physical Chemistry Experiments	37 Conversation: Designing Lab Classrooms to Support Instructional Goals
12–1	PACCT Luncheon, Langone Center 241 Rooms							

Thursday

Time	Coleman 101B	Vaughan Lit. Aud.	Coleman 202A	Bus Stop Weis Center	Bio 105	Dana 5A	Library Mac Lab	Bio 101, 102 & 104
9:30–12	57E Chemistry Majors Courses / Curriculum	57F First-Year Chemistry Curriculum	57G Using History in Teaching Chemistry	100 Priestley House Pilgrimage	113 Hands-on Polymer Experiments and Demonstrations	122 Strength of Materials. 122 Strength of Materials.	126 Search CAS On-Line by Structure. 126 Search CAS On-Line by Structure.	127 Research In Chemistry Education.

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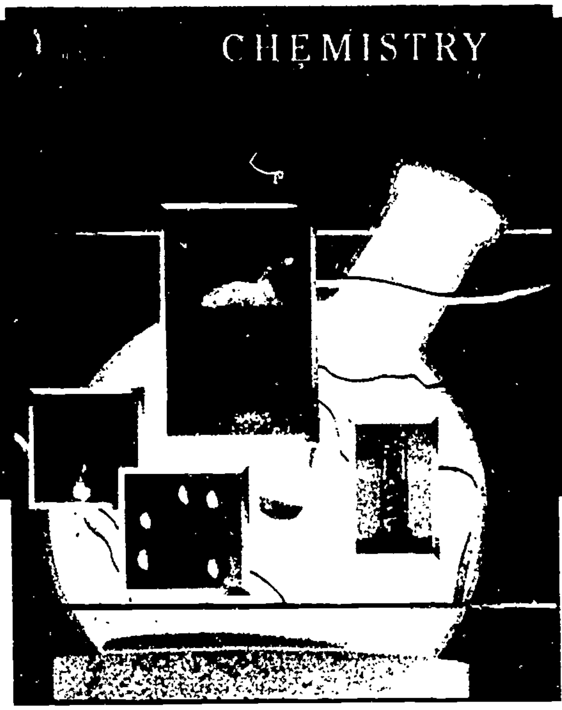

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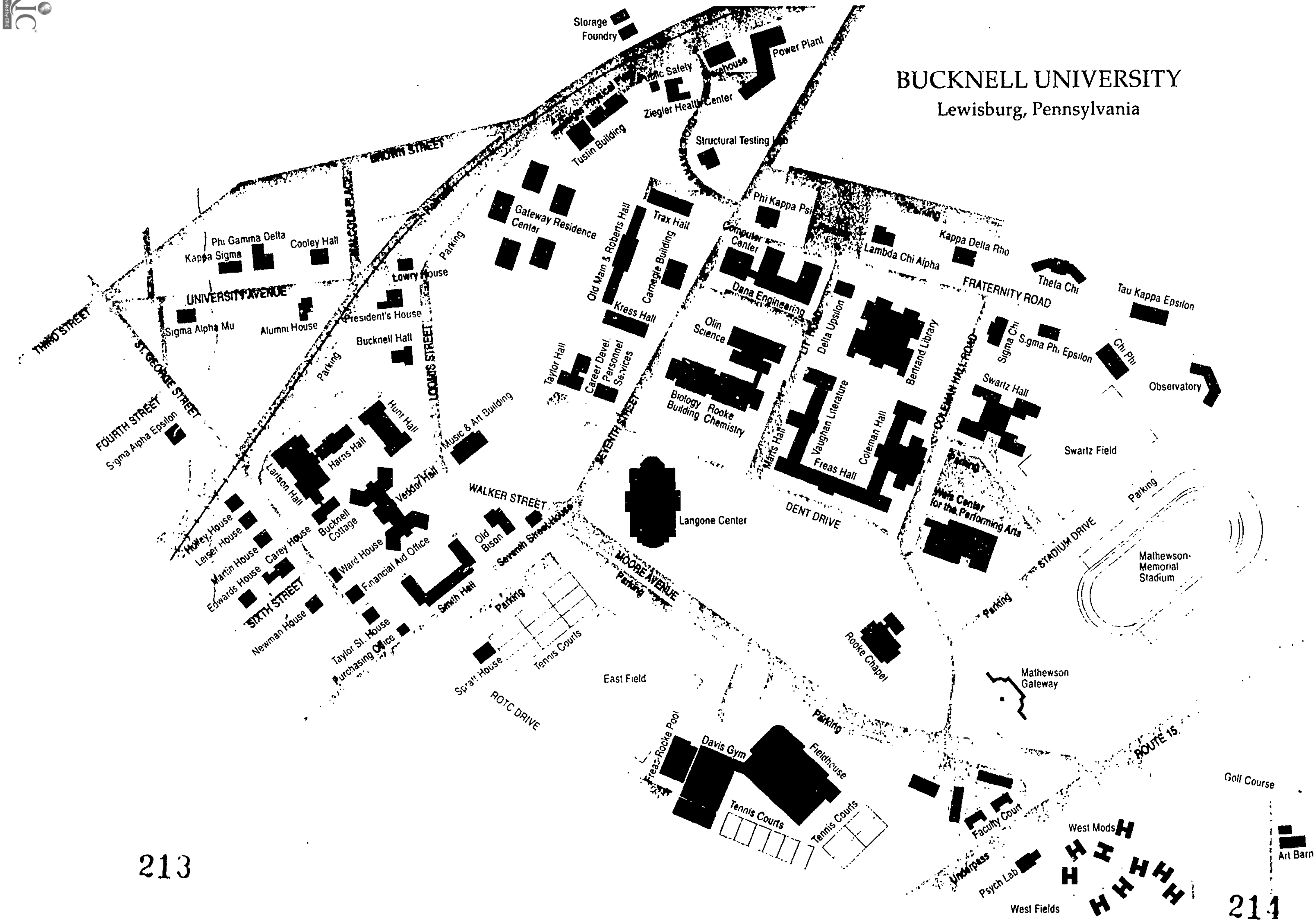

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