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ABSTRACT

This environmental education program emphasizes the cause and effect of change in a city ecosystem with special attention given to man and his role in environmental change. Concepts are employed from the natural and social sciences to investigate environmental problems. Unit activities are inquiry oriented and answer these questions: (1) What is an ecosystem?; (2) What is a description of the ecosystem being investigated?; (3) What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?; (4) Where are some specific locations of the ecosystem being investigated?; (5) What biotic and abiotic features in the ecosystem have changed and are undergoing change?; (6) What are the natural factors causing change in the ecosystem and how have they been changed?; (7) What are the man-made factors causing change in the ecosystem and how have they been brought about?; (8) What are the results of the changes?; (9) What, if any, new changes are needed in the ecosystem?; and (10) How might these needed changes to the ecosystem be brought about? Questions 6-8 are answered through population, water supply, and air pollution activities. The teacher's guide also contains resources, evaluation techniques, and teacher suggestions for program implementation. Readings, maps, and other handouts are given for learner use. (Author/MR)


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MAN'S IMPACT ON THE ENVIRONMENT

MAN'S IMPACT ON THE ENVIRONMENT

An Environmental Learning Unit

Developed as a portion of the

ESEA, Title III, Project #050-2323-73003

"BROAD SPECTRUM ENVIRONMENTAL EDUCATION PROGRAM"

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RATIONALE

Environmental degradation is recognized as a concern of increasing magnitude. Man is the precipitating factor in the deterioration of the human and non-human factors of his environment, his highly touted accomplishments notwithstanding. It is postulated that environmental problems are exacerbated by man's lack of knowledge and understanding of his surroundings, both physical and social, as well as individual motivation to act respectfully toward his environments.

This broad spectrum environmental education program has been developed to combat this shortage of understanding and feeling. Employing concepts from both the disciplines of natural and social sciences, a learner can be exposed not only to the physical phenomena that are being affected in his environment but also can be made aware of the human consequences of these changes. The application of the self-discovery techniques used in this learning activity package will result in a learner who:

1. Demonstrates a significantly increased level of knowledge and understanding of the interrelationship of both human and non-human aspects of his environment.
2. Demonstrates a significantly higher positive attitude toward his environment.

By accomplishing these objectives with a substantial number of students, they would be equipped with the basic tools with which to actively pursue solutions to environmental problems.

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The City as an Ecosystem

FOREWORD

Man's Impact on the Environment is a learning activity package designed to foster an improvement in the learner's knowledge of and attitude toward his environment. As the title might suggest, this package views man as he affects his environment, both the living and non-living features. Consequently, the unit of analysis used for this study is the ecosystem, a system in which the many relationships among the living (biotic) and non-living (abiotic) aspects of any given environment are investigated.

The ecosystem view of the environment is brought into sharp focus by utilizing the conceptual theme of change. Biological, physiological, and sociological change are all facets of this particular conceptual approach. Major emphasis is given to the cause and effect of change in an ecosystem and special attention is given to man and his role in environmental change.

To facilitate the investigation of change in various ecosystems, an analytical model - a series of generalized but basic questions applicable to a number of similar units of analysis - about change in an ecosystem has been developed. In Man's Impact on the Environment, learning activities are provided that apply this analytical model to a series of specific ecosystems: barrier beach, estuary, freshwater marsh, the city. It is believed that once a learner becomes acquainted with this model, he can use it as a guide to study any ecosystem he wishes.

The application of this model to selected ecosystems is made through an inquiry, or self-discovery, learning approach. Even though the learning activities are based on a very directed inquiry technique, the learner still benefits from using his analytical skills, gaining facts, and exploring and clarifying his values and attitudes toward the environment.

How To Use This Learning Packet

This learning activities package is divided into three major sections -- Learning Activities, Student Comments (SC) and Teacher Comments (TC). The Learning Activities section provides investigations for each inquiry question listed in the analytical model. These investigations are designed to guide the learner toward a well grounded conclusion to the inquiry questions. Along with the Learning Activities, this division includes Resources needed to complete the investigations, suggested Evaluation procedures for student performance, and Teacher Suggestions. The evaluation techniques are explained in depth later in this Foreward. Student Comments are readings, maps, and other handouts that are integral parts of the Learning Activities and are to be reproduced for learner use. The Student Comments are numbered and located all together following the section on Learning Activities. Teacher Comments give background information on a variety of aspects of the ecosystem being studied. Even though the Teacher Comments are primarily designed for the teacher, many instructors have found it useful to reproduce these for their students to use.

In an effort to make this learning packet as student-oriented as possible, there has been included an explanation of a workable program in which students conduct class discussion. Read carefully the following Suggested Model for Student-Directed Class Discussion for possible implementation in your classroom.

Man's Impact on the Environment also provides a series of suggested methods for evaluating learner performance. Employment of these particular techniques are not critical to the success of the learning unit, but are procedures that have proved meaningful to the classroom teachers who developed this learning activity package. A Proposed Scheme of Techniques for Evaluating Student Performance merits close attention and can be found in this Foreward.

A Suggested Model for Student-Directed Class Discussion

"The only learning which significantly influences behavior is self-discovered, self-appropriated learning. Self-appropriation or 'learning it for myself' happens when there is process, or when the student is an activist . . . or when the student is searching, or when the student is doing anything with the teacher -- like understanding or loving him."*

One process that can be actively utilized for self-discovered learning is the student-directed class discussion. Discussion revolving around challenging, inquiry oriented questions supplied by the teacher, but conducted exclusively by the students, will provide the participants the opportunity for active involvement. Student-directed discussions allow the student to express opinions openly and argue freely for his point of view in an atmosphere monitored by his peers instead of the, more often than not, staid question and answer situation structured by the teacher.

Class discussions directed by students also free the teacher to become a sharper observer of student interaction, a better listener, and more effective evaluator. By allowing students the chance to conduct class discussions and refraining from voicing personal opinions and making authoritative statements, the teacher will have more time to observe, listen, and evaluate. Student confidence is developed when the teacher allows them to work out their own problems and acts as a guide and not the sole intellectual authority in the room. Teacher suggestions should be offered sparingly and only if students get too far off the subject and just can't get back to the business at hand.

One highly successful model for student-directed class discussion has been employed for several years in social studies classes at DeLaura Junior High School, Satellite Beach, Florida.

* Carl Rogers

Students assume the three following positions: (1) Moderator, (2) Board Recorder, (3) Desk Recorder. These positions are all voluntary and students may choose to be one, two, or all three, not all at once. A sheet of paper for each position may be passed around the room, and students may sign up for any, all, or none of these. When any position is needed, the teacher can just pick one student, starting at the top of the list. Moderator and Board Recorder serve one class period and the Desk Recorder serves throughout the entire discussion of the overall issue. These positions are excellent for those quiet, shy students who hesitate to express their opinions in a large group. A teacher should award extra points to those students who volunteer for these positions.

(1) The Moderator - Responsibilities

A. Calls on students who wish to express themselves.

B. Continues to call on students who wish to speak as long as there is quiet cooperation of the remaining students.

C. Maintains parliamentary procedure. (Simple parliamentary procedure might be explained by the teacher -- point of order, call for question, making a motion, etc.)

D. Does not express an opinion.

(2) The Board Recorder - Responsibilities

A. Records pertinent information on chalkboard as directed by students so that the Desk Recorder can make a copy of the information for the class log and help keep discussion on the point.

B. May express opinions when recognized by the Moderator.

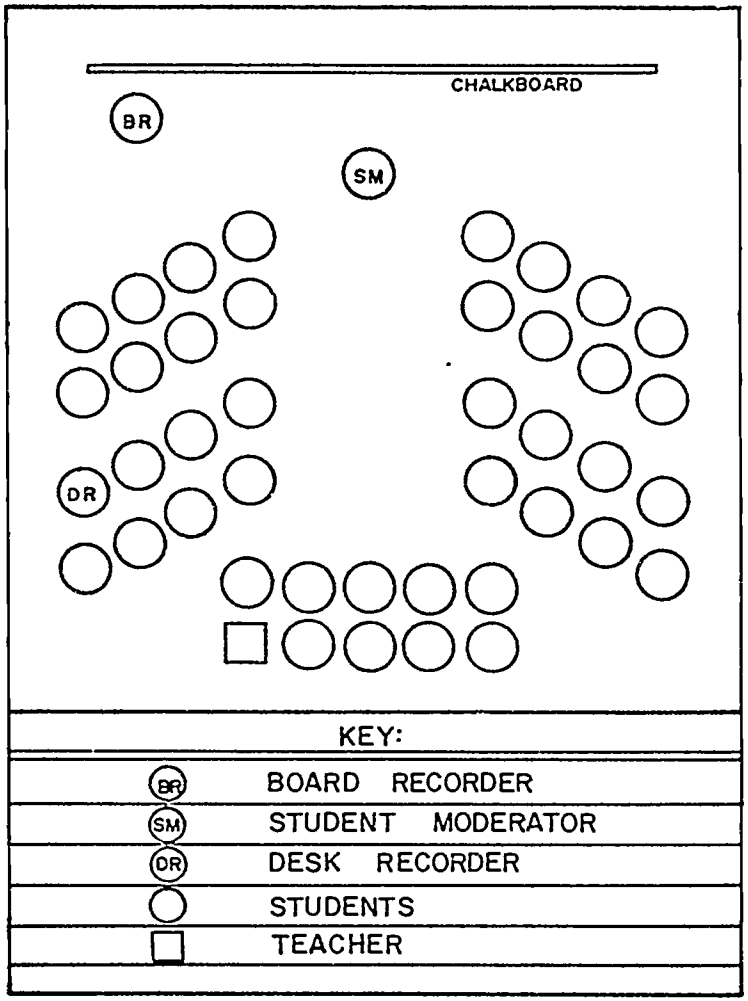
(3) The Desk Recorder - Responsibilities

A. Records in a class log information exactly as it appears on the chalkboard.

B. Acts as secretary when arguments occur over previous material by referring to previous records in log.

C. Places previous day's work on chalkboard at the beginning of each class meeting.

D. Records information on ditto at the conclusion of the discussions for distribution to members of the class.



Physical arrangements of the class environment contribute significantly to class discussion. Desks should be situated so that students can generally face each other for easier interaction and see the chalkboard without difficulty. See diagram at left.

Remember! The teacher is an observer, listener, and evaluator! One suggested scheme for evaluating large group discussion is explained in the next section on Evaluation Techniques. If this Student-Directed Class Discussion is to be adopted in your classroom, thorough explanation should be made to your students before starting the unit of study.

-David MacDonald, June Schmidlkofer
Social Studies teachers
DeLaura Junior High school
Satellite Beach, Florida

A Proposed Scheme of Techniques for Evaluating Student Performance

Evaluating student performance is difficult at best. Most classroom teachers have developed systems for "grading" their students with which they are most comfortable. Other teachers are quite uncomfortable with any techniques for measuring student progress. We make no attempts at solving the problems and inequities inherent in most evaluation schemes. We only present some ways that some classroom teachers have used and have found to be successful for them. Please review the suggested methods included here and modify for use in your own situation. Whatever general evaluation process is chosen, explain its function to your students before beginning the unit of study.

Student achievement can be evaluated on more than written tests, even though these have their place. Additional areas of measurement may include large group discussion, small group work, self-evaluation, oral reports, visual creations (posters, charts, graphs, diagrams, collages), and written assignments.

One suggested method of scoring these and other areas is through a point system in which a higher number of points reflects higher quality. A point scale is established for each area being judged, points are granted either by students or teacher for an individual's performance and each student records his own accumulation of points. This record could take the form of an Individual Point Sheet (I.P.S.) shown on the next page. The sheet serves as a summary for points given in the four categories of evaluation discussed in this section on Evaluation Techniques. Other aspects of evaluation, not included on the Individual Point Sheet may be included at the teacher's discretion. Be creative and reward your students for the good they do. Accentuate the positive and eliminate the negative.

Point Sheets are kept for one week at a time by the student who totals his points and then turns them in to the teacher. At the end of a standard grading period, all I.P.S. totals are added and the teacher converts them into a grade.

Each of the divisions on the I.P.S. are explained on the following pages and detailed scoring instruments are provided for your consideration in the Teacher Comment section.

INDIVIDUAL POINT SHEET

Name _____

Total Points _____

Period _____

Week _____

Large Group Discussion Points

M.
T.
W.
Th.
F.

Sub-total _____

Self-Evaluation Points

M.
T.
W.
Th.
F.

Sub-total _____

Small Group Work Points

M.
T.
W.
Th.
F.

Sub-total _____

Oral-Visual-Written Points

M.
T.
W.
Th.
F.

Sub-total _____

Large Group Discussion

Large group discussion is probably the most widely used learning technique in the classroom. Most of the time this type of discussion is teacher-centered or directed. However, it is possible for class discussions to be student directed; this leaves the teacher free to be an observer, listener, and evaluator. The section, A Suggested Model for Student-Directed Class Discussion, page ix, gives details in how to establish a student-directed discussion.

With students directing class discussion the teacher has the opportunity to become a more reliable evaluator. Most teachers have their own methods for judging their students' comments as a group discussion progresses, however for those instructors who may wish some help in this matter we have included a sample checklist in the Teacher Comment Section as a possible measuring device.

Large group discussions are used frequently throughout this unit of study, especially as a technique for summarizing or reaching a concluding answer to the Inquiry Question being investigated. Class discussion has been shown to be one of the students' favorite means for learning, therefore it is an excellent opportunity for the teacher to evaluate young people's thinking and expression. If the suggested checklist mentioned above is to be employed, explain its use to the students before the unit of study is begun.

Small Group Work

Small Group Work is an effective method used to develop communication, cooperation, self-expression, leadership, creativity, interaction and sharing of ideas and knowledge. This technique is successful with students in most learning situations.

The purpose of this technique is to develop a student-centered classroom rather than a teacher-directed classroom. Through these small group discussions, students feel freer to express themselves and some develop leadership skills which are not present in large groups. Other benefits are that students learn to work or cooperate with a variety of their peers and not just the same group all the time. Most students learn to cope with a new situation and/or problem to solve. It is imperative that a teacher strive to allow students to solve their own group problems. Teachers should allow students in small groups to elect their leadership except in No. 4 (Captain-selection) of the ideas below.

Here are some suggested ways to organize students into small groups.

1. Counting-off
   a. Decide the number of groups needed.
   b. Suggest four to six members in each group.
   c. Start count anywhere in the room with #1 and go to desired number (4-5-6).
   d. Continue counting off until all students are members of a group.

2. Drawing numbers
   a. Same as No. 1a above.
   b. Same as No. 1b above.
   c. Put in a box the desired sets of numbers.
   d. Students will draw from the box a numbered slip of paper which will determine their group.

3. Self-grouping
   a. Arrange furniture prior to class meeting for desired number of groups.
   b. Choice of location selected by student upon entering the room.

4. Captain-selection
   a. Count off and select desired number such as every tenth person from the rollbook. Student has choice of being or not being a captain.
   b. Continue this until the desired number of captains have been obtained.
   c. Position captains at various stations in the room, as selection is being made.
   d. Captain selects team members. Captain's position is rotated among team if desired.
   e. Continue until all members of the class are on a team.

- David McDonald, June Schmidlkafor
Social Studies Teachers
DeLaura Junior High School
Satellite Beach, Florida

Many teachers refuse to incorporate small group work in their classrooms because they lack a satisfactory procedure for evaluating the outcome of such efforts. For the purpose of this unit of study, we suggest the use of the following process for checking the results of groups investigating each Inquiry Question. Use only where it is practical to do so.

1. At the end of the study of each Inquiry Question, there will be an exercise in the Learning Activities column entitled Check I. Q. At this point have each individual within a small group write out what he thinks is the answer to the Inquiry Question, by filling out the upper half of the I. Q. (Inquiry Question) Check form provided in the Student Comment section.

2. Teacher collects I. Q. Check sheets and gives to a different small group for grading.

3. Class members will:
   a. Have in front of them a copy of class conclusion for the Inquiry Question arrived at during the Investigations.
   b. Decide how many total grade-points should be possible for the proper response to the Inquiry Question.

4. Each small group will compare the answer sheet handed it with class conclusion and then fill out the lower half of the I. Q. Check form. Experience has shown that more honest and serious evaluations are made when students do not know who is checking whose paper. The name of the checker on the I. Q. Check form is for the teacher only.

5. Return I. Q. Checks to teacher who may reveal scores to students.

If this method of evaluation is employed, it would be essential for students to remain in the same small group until completion is made of all investigations for any one Inquiry Question.

Self-Evaluation

Appraising one's own progress is probably the most effective means of evaluation. No one better than the student himself knows how interested he was in the subject, how clearly he understands the concepts, how much effort was expended on the learning activities, or how much cooperative participation he took in group ventures. A system of self-evaluation can guide a student to a place where he can see his own strong features as well as weak ones. From this vantage point, he can begin to make constructive changes in his behavior.

In the Student Comment Section there is provided one sample measuring device which could be utilized throughout this unit of study. If this instrument or some similar form is adopted, please explain its use to students before any learning activities start.

Oral - Visual - Written Assignments

Variety is a key to comprehensive evaluation of student progress. Oral reports, visual creations and written assignments are but a small list of activities that can be used to measure the growth of students. While formal oral presentations are at a minimum in these units of study, they may be required and we have included a sample form for evaluating such reports in the Teacher Comment Section. Visual work is called for more frequently throughout the learning activities, therefore we have suggested some guidelines for scoring this type of effort in the Teacher Comment Section. These two forms could be easily modified for any local situation. The range of written assignments requested is so great that the evaluation of this area is left completely up to the teacher. Whatever methods for evaluating oral, visual, and written assignments are applied should be carefully explained to students before beginning the unit of study.

ACKNOWLEDGEMENT

This Project would have been impossible without the efforts and cooperation of the classroom teachers who helped develop, test, and revise these environmental learning units. The assistance given by Dr. Edwin Shirkey, of Florida Technological University in Orlando, Florida, to evaluate the students' performance outcomes was invaluable. Students participating in all the Pilot Classes made many constructive suggestions for revising the learning units.

Special mention goes to those teachers who performed extra tasks. David MacDonald and June Schmidlkofer were instrumental in writing A Suggested Model for Student-Directed Class Discussion and parts of the section on evaluating student performance. Eric Johnson, Robert Findlay and JoAnn Stringer acted as the revision committee, making the changes that made this final product possible. Nina Belle Fritz, Ellen Claussen and Linda Lincoln spent hours drawing up a package of material that would explain to teachers how they could use Man's Impact on the Environment.

My greatest appreciation is extended to all of these individuals.

Roger L. Henry
Chairman

LOOKING AHEAD

Looking Ahead is a feature provided for those teachers who wish to be prepared for the learning activities by securing the needed resources not supplied within this package before it is time to use them.

Looking Ahead at the City

	Resource Needed	Place Used (Page Number)
1.	Filmstrip: Keys to Basic Ecology	3
2.	Film: City Limits	6
3.	Filmstrip: New York City: An Environmental Case Study	8
4.	Population maps	12
5.	Special magazines	23
6.	Library time	26
7.	Debate guidelines	26
8.	Materials for experiments	37-38
9.	Filmstrip: Pollution: Our Air	39
10.	Magazines, newspapers	39
11.	Filmstrip: Urban Civilization	46

A MODEL FOR INVESTIGATING CHANGE IN ECOSYSTEMS

An Inquiry Study

I. What is an ecosystem?

II. What is a description of the ecosystem being investigated?

III. What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?

IV. Where are some specific locations of the ecosystem being investigated?

V. What biotic and abiotic features in the ecosystem have changed and are undergoing change?

VI. What are the natural factors causing change in the ecosystem and how have they been brought about?

VII. What are the man-made factors causing change in the ecosystem and how have they been brought about?

VIII. What are the results of the changes?

A. Beneficial?
B. Detrimental?

IX. What, if any, new changes are needed in the ecosystem?

X. How might these needed changes to the ecosystem be brought about?

LEARNING ACTIVITIES

Introduction

(Inquiry Questions I — V)

Inquiry Question:

I. What is an ecosystem?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1: A. INTRODUCE 1. Write this question on chalkboard: "What is an ecosystem?" 2. Tell class they are going to: a. Observe an ecosystem. b. Record all they see or sense in their observations. c. Predict a definition of ecosystem.	A. INTRODUCE	A. INTRODUCE	A. INTRODUCE 1. This Investigation will lead students to define ecosystem. 2. The school grounds will serve as an adequate ecosystem for observation.
B. OBSERVE 1. Divide class into small groups. 2. Take groups outside on school grounds and deploy at various sites. 3. Tell all groups to record all they see and sense in their surroundings.	B. OBSERVE	B. OBSERVE	B. OBSERVE
C. PREDICT/DISCUSS 1. Using their recorded observations, have each group develop a predicted definition of ecosystem. 2. Have each group report its definition to the class and through discussion, reach a consensus on the meaning of ecosystem.	C. PREDICT/DISCUSS	C. PREDICT/DISCUSS Collect written copies of definitions and check.	C. PREDICT/DISCUSS 1. At this time, do not make any comment on whether or not the definition is correct. 2. Record consensus on chalkboard.

Inquiry Question:

I. What is an ecosystem?

Learning Activities	Resources	Evaluation	Teacher Suggestions
D. VIEW 1. Tell the class they are going to: a. View a sound filmstrip b. Compare their definition of ecosystem with what they see and hear. c. Revise their class definition if necessary. 2. Show filmstrip on ecology.	D. VIEW 1. Keys to Basic Ecology "Interrelationship Set" Filmstrip #1 - Ecosystem. 2. Order from: Olin Educational Services, 460 Park Ave., New York, N. Y. 10022.	D. VIEW	D. VIEW 1. An alternate filmstrip that could be used: a. Our Environment: Problem or Promise, Filmstrip #211 - "Ecology: The Web of Nature." b. Order from: A. J. Nystrom and Co., 3333 Elston Ave., Chicago, Illinois 60618. 2. Any local visual-aid that shows the definition of an ecosystem can be used.
E. DISCUSS 1. Through class discussion, revise predicted class definition if needed. 2. Familiarize students with the meaning of biotic and abiotic, as they relate to the definition of ecosystem. These words will be used throughout the unit of study.	E. DISCUSS	E. DISCUSS	E. DISCUSS 1. One definition of ecosystem -- "a system in which the biotic (living) and abiotic (non-living) features are in constant interaction." 2. Meanings: Biotic means all things living or recently living. Abiotic means all things non-living. Bio- from the Greek, bios, meaning life. A- from the Greek, meaning not.

Inquiry Question:

I. What is an ecosystem?

Learning Activities	Resources	Evaluation	Teacher Suggestions
			3. TC #1, page 121, will help in a detailed discussion of what is considered living and not living.
F. OBSERVE 1. Divide class into small groups. 2. Tell students they are going to: a. Check their new definition with the eco-system they first observed. b. List specific examples of: (1) biotic/abiotic features they observe (2) relationships among those features. 3. Take students back out to school grounds.	F. OBSERVE	F. OBSERVE Collect list of observations.	F. OBSERVE Remind students to carry a revised definition with them to the school grounds.
G. DIAGRAM Have each group work together using observation lists and produce one diagram which illustrates the various interdependent relationships among the biotic and abiotic.	G. DIAGRAM	G. DIAGRAM Collect diagrams and check.	G. DIAGRAM 1. Suggest that arrows (→) could be used to show relationships. 2. This could be an individual assignment and worked on at home.

Inquiry Question:

I. What is an ecosystem?

Learning Activities	Resources	Evaluation	Teacher Suggestions
H. CHECK I. Q. Have students check results of their small group work.	H. CHECK I. Q.	H. CHECK I. Q. SC #1, p. 48.	H. CHECK I. Q. TC #2, p. 128, gives procedure for this check.
I. EVALUATE SELF Have students evaluate themselves.	I. EVALUATE SELF	I. EVALUATE SELF SC #2, p. 49.	I. EVALUATE SELF If Individual Point Sheets (I. P. S.) are to be used, reproduce sample form on page xiii of the Foreword and distribute to students.

Inquiry Question: II. What is a description of the ecosystem being investigated?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1: A. VIEW 1. Tell class they will: a. See a picture of an ecosystem. b. Write a full description of what this ecosystem is like. 2. Show pictures. B. DISCUSS/DESCRIBE 1. In class, have students give a full description of what they think makes up this ecosystem (city). 2. Record final description on chalkboard. C. VIEW To verify their description, show students the film, "City Limits." D. REWRITE Rewrite class description of city if necessary.	A. VIEW SC #3, p. 50. B. DISCUSS/ DESCRIBE C. VIEW City Limits ACI Films, Inc. Distribution Cnt. P. O. Box 1898 12 Jules Lane New Bruinswick New Jersey 08902 D. REWRITE	A. VIEW B. DISCUSS/ DESCRIBE TC #3, p. 129. C. VIEW D. REWRITE	A. VIEW 1. The pictures in SC #3 could be reproduced on spirit masters or acetate transparencies. 2. Pictures could be shown on opaque projector. B. DISCUSS/DESCRIBE 1. TC #4, p. 130. 2. After students describe city, TC #4 could be discussed. C. VIEW A sound filmstrip also good for this activity: The City as an Ecosystem (Filmstrip #1) Interpretive Education 400 Bryant Street Kalamazoo, MI 49001 D. REWRITE Have each student make copy of revised city description.

Inquiry Question: II. What is a description of the ecosystem being investigated?			
Learning Activities	**Resources**	**Evaluation**	**Teacher Suggestions**
E. CHECK I. Q. Have students check results of their small group work.	E. CHECK I. Q.	E. CHECK I. Q. SC #1, p. 48.	E. CHECK I. Q. TC #2, p. 128, gives procedure for this check.
I. EVALUATE SELF Have students evaluate themselves.	I. EVALUATE SELF	I. EVALUATE SELF SC #2, p. 49.	I. EVALUATE SELF If Individual Point Sheets (I. P. S.) are to be used, reproduce sample form on page xiii of the Foreword and distribute to students.

Inquiry Question:

III. What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1 A. VIEW 1. Divide class into small groups. 2. Show Part 2 of the filmstrip and have students list biotic and abiotic features of the city mentioned directly or indirectly. 3. Keep list for further use. B. READ Have small groups read SC #'s 4, 5, 6, and note biotic and abiotic features found in the city. C. DIAGRAM 1. Using the notes from reading and list from the filmstrip, diagram the relationships between biotic and abiotic phenomena in the city. 2. All students contribute to making one diagram for the entire group.	A. VIEW New York City: An Environmental Case Study, Denoyer-Geppert Audio-Visuals, New York, New York. B. READ SC #'s 4, 5, 6, pp. 53-55. C. DIAGRAM	A. VIEW Collect a copy of the list and evaluate. B. READ C. DIAGRAM Collect diagram and evaluate with TC #5, p. 131.	A. VIEW Another sound filmstrip good for this activity: The City as an Ecosystem (Filmstrip #4) Interpretive Education 400 Bryant Street Kalamazoo, MI 49001 B. READ C. DIAGRAM

Inquiry Question:

III. What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #2: A. DISCUSS/LIST 1. Divide class into small groups and have them decide on an answer to this question: What is the one most dominant biotic feature of the urban ecosystem? (man) 2. Have groups list the major basic needs, both biotic and abiotic, required to form an urban ecosystem. B. REPORT/DECIDE 1. Have each group report their list to the class. 2. As a class, reach a conclusion on a composite list of basic needs. C. LIST/DISCUSS 1. Make a list of useful products and services that one finds in the city. 2. Make a second list of non-useful by-products of services and products found in the city.	A. DISCUSS/LIST B. REPORT/DECIDE C. LIST/DISCUSS	A. DISCUSS/LIST Collect a copy of the list to check progress of students. B. REPORT/DECIDE TC #3, p. 129. C. LIST/DISCUSS Collect lists and check.	A. DISCUSS/LIST 1. The use of the word dominant in the student question is to reflect the influence man has on his environment. 2. The major basic needs list may include, but not be limited to, the following: - people - air - water - energy (power) - food - raw materials for manufacturing B. REPORT/DECIDE C. LIST/DISCUSS

Inquiry Question:

III. What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?

Learning Activities	Resources	Evaluation	Teacher Suggestions
3. Consider both lists carefully and then defend or refute in class this statement: - "The disadvantages and drawbacks of the city far outweigh its advantages and benefits."			
D. REPORT/CONCLUDE 1. Have each group report their list to class. 2. As a class, reach a decision on a composite list of non-useful by-products.	D. REPORT/CONCLUDE	D. REPORT/CONCLUDE TC #3, p. 129.	D. REPORT/CONCLUDE
E. DIAGRAM Have each student, using the lists from Activities B and D, construct a single diagram illustrating the basic needs (input) and the non-useful by-products (output) of the urban ecosystem.	E. DIAGRAM	E. DIAGRAM Collect diagrams and evaluate with TC #5, p. 131.	E. DIAGRAM Place representative diagrams on bulletin board.
F. REPORT/DECIDE 1. Have each group report their diagram to the class. 2. After discussing all reported diagrams, have class decide on a composite diagram.	F. REPORT/DECIDE	F. REPORT/DECIDE 1. TC #3, p. 129. 2. TC #6, p. 132.	F. REPORT/DECIDE Make a record of composite diagram for use in later activities.

Inquiry Question:

III. What are some of the biotic and abiotic features of the ecosystem and how do these features interrelate?

Learning Activities	Resources	Evaluation	Teacher Suggestions
G. CHECK I. Q. Have students check results of their small group work.	G. CHECK I. Q.	G. CHECK I. Q. SC #1, p. 48.	G. CHECK I. Q. TC #2, p. 128, gives procedure for this check.
I. EVALUATE SELF Have students evaluate themselves.	I. EVALUATE SELF	I. EVALUATE SELF SC #2, p. 49.	I. EVALUATE SELF If Individual Point Sheets (I. P. S.) are to be used, reproduce sample form on page xiii of the Foreword and distribute to students.

Inquiry Question:

IV. Where are some specific locations of the ecosystem being investigated?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1 A. DISCUSS/LIST 1. Divide class into small groups. 2. Ask each group to discuss and list answers to the following question: Which urban ecosystems (cities) are most likely to have the most persistent environmental problems? B. LOCATE/LIST 1. Using a series of population density maps (world, national, state, local) have students locate and note several highly populated cities in each of the following categories: - world (at least one on the six most populated continents) - national - state - county 2. Have students make a list of the most populated cities, placing them under the proper category heading.	A. DISCUSS/LIST B. LOCATE/LIST Population density maps usually can be found in your school's social studies department.	A. DISCUSS/LIST Collect a copy of the list and check student progress. B. LOCATE/LIST Collect lists and evaluate.	A. DISCUSS/LIST Students undoubtedly will select cities that are the most populated as a general answer to their question. B. LOCATE/LIST 1. TC #7, p. 133, gives a list of the world's most populated cities. 2. If world outline maps are available, it would be good for students to place a symbol on the map denoting world location of major cities. This will help students see environmental problems are worldwide. 3. Have students keep list for use in a later activity.

Inquiry Question:

IV. Where are some specific locations of the ecosystem being investigated?

Learning Activities	Resources	Evaluation	Teacher Suggestions
C. CHECK I. Q. Have students check results of their small group work.	C. CHECK I. Q.	C. CHECK I. Q. SC #1, p. 48.	C. CHECK I. Q. TC #2, p. 128, gives procedure for this check.
D. EVALUATE SELF Have students evaluate themselves.	D. EVALUATE SELF	D. EVALUATE SELF SC #2, p. 49.	D. EVALUATE SELF If Individual Point Sheets (I. P. S.) are to be used, reproduce sample form on page xiii of the Foreword and distribute to students.

Inquiry Question:

V. What biotic and abiotic features in the ecosystem have changed and are undergoing change?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1 A. RANK 1. Divide class into small groups. 2. Review the composite diagram of a city's basic needs and nonuseful by-products. 3. Rank in descending order, the needs and by-products which are thought to be changing the most and causing cities the most problems.	A. RANK Diagram from Inquiry Question III, Investigation #2, Activity E.	A. RANK Collect rank lists and evaluate.	A. RANK
B. REPORT/DECIDE 1. Have each group report to the class. 2. Have class decide on one acceptable ranking of changes in the needs and by-products.	B. REPORT/DECIDE	B. REPORT/DECIDE TC #3, p. 129.	B. REPORT/DECIDE
C. DISTINGUISH Through class discussion, distinguish the ranked changes as to their being biotic, abiotic, and/or a combination of biotic and abiotic features.	C. DISTINGUISH	C. DISTINGUISH TC #3, p. 129.	C. DISTINGUISH The remainder of this unit of study will deal with the following specific changes in the urban ecosystem: - population - water supply - air pollution

Inquiry Question:

V. What biotic and abiotic features in the ecosystem have changed and are undergoing change?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #2			
A. TAKE QUIZ Have students answer diagnostic survey in SC #7, Part I.	A. TAKE QUIZ SC #7, p. 56.	A. TAKE QUIZ Do not use score for evaluation.	A. TAKE QUIZ This quiz serves as an introduction to the major changes in the city which we will investigate.
B. DISCUSS QUIZ Give answers to Quiz by having students read SC #7, Part II, and discuss reactions.	B. DISCUSS QUIZ SC #7, Part II, p. 57.	B. DISCUSS QUIZ TC #3, p. 129.	B. DISCUSS QUIZ
C. ANALYZE QUIZ Have students in class discuss and list on chalkboard what major subjects are mentioned in the quiz.	C. ANALYZE QUIZ	C. ANALYZE QUIZ TC #3, p. 129.	C. ANALYZE QUIZ 1. Students no doubt will list these subjects: - population - energy - water supply - waste disposal - air pollution - noise 2. Refer to the appropriate sections of this quiz as each subject is studied in subsequent investigations.

Inquiry Question:

V. What biotic and abiotic features in the ecosystem have changed and are undergoing change?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #3			
A. READ Have students read SC #8.	A. READ SC #8, p. 58.	A. READ	A. READ This investigation may be unnecessary, if students have already reached an understanding of this Inquiry Question.
B. LIST Have students list changes in the city environment.	B. LIST	B. LIST Collect list.	B. LIST
C. CONSOLIDATE 1. Through class discussion, make one composite list of changes. 2. Have students categorize changes by biotic and abiotic.	C. CONSOLIDATE	C. CONSOLIDATE	C. CONSOLIDATE Use this list as a springboard to the rest of the unit of study.

Investigations 4, 5, and 6 emphasize three demographic facets of change in the city's most dominant biotic feature — population.

Inquiry Question:

V. What biotic and abiotic features in the ecosystem have changed and are undergoing change?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #4			
A. PREDICT Have students predict the change in city population over the last 30 years in the U. S. (Has it increased or decreased?)	A. PREDICT	A. PREDICT	A. PREDICT This investigation explores one aspect of U. S. population change -- distribution.
B. VERIFY Show SC #9 to students to verify their predictions.	B. VERIFY SC #9, p. 60.	B. VERIFY	B. VERIFY
C. DISCUSS Have students discuss in class: - The meaning of central city and suburb. - The population changes that have actually occurred in the U. S. during the last 30 years. - The possible results of change in population distribution over the past 30 years.	C. DISCUSS	C. DISCUSS TC #3, p. 129.	C. DISCUSS Central city is usually thought to be the business, cultural, governmental hub of an urban area. Suburbs are the residential districts surrounding the central city.
Investigation #5			
A. GUESS Ask students to make an educated guess to these questions: - Is the U. S. birth rate declining or not? - Why?	A. GUESS	A. GUESS	A. GUESS This investigation is concerned with a feature of U. S. population change -- declining birth rate.
B. REVIEW Have students review SC #10 to check their "guesses."	B. REVIEW SC #10, p. 62.	B. REVIEW	B. REVIEW

Inquiry Question:

V. What biotic and abiotic features in the ecosystem have changed and are undergoing change?

Learning Activities	Resources	Evaluation	Teacher Suggestions
C. DISCUSS Discuss these questions: - What change actually occurred in the U. S. birth rate? - What man-made factors most likely caused this change? - What are possible results of this change?	C. DISCUSS	C. DISCUSS TC #3, p. 129.	C. DISCUSS
Investigation #6			
A. ASK Ask students what has been happening with world population in general (not just in cities) during the last decade? Has it increased or decreased?	A. ASK	A. ASK	A. ASK This investigation relates to an element of world population change — increase in total population.
B. SHOW/DISCUSS 1. Show students SC #11 to prove (or disprove) their answer. 2. Discuss these questions: - What factors (natural/man-made) may have caused this change? - How did these factors occur? - What are possible results of this change?	B. SHOW/DISCUSS SC #11, p. 63.	B. SHOW/DISCUSS TC #3, p. 129.	B. SHOW/DISCUSS Start discussion by students answering these questions: - Which world areas have the largest population? - Why do you think these are the largest populated areas?
C. CHECK I.Q. Have students check results of their small group work.	C. CHECK I.Q.	C. CHECK I.Q. SC #1, p. 48.	C. CHECK I.Q. Even though small groups were not used in these investigations, the I.Q. Check (SC #1, p. 48) may be modified.
D. EVALUATE SELF Have students evaluate themselves.	D. EVALUATE SELF	D. EVALUATE SELF SC #2, p. 49.	D. EVALUATE SELF

LEARNING ACTIVITIES

Cause/Effect of Specific Changes

(Inquiry Questions VI – VIII)

POPULATION

Inquiry Question:

VI. What are the natural factors causing change in the ecosystem and how have they been brought about?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1 A. STUDY Have students read SC # 12 and carry out the activities suggested. B. DISCUSS 1. Discuss results of "The Black Death" study activities (SC#12). 2. Ask students: a. What natural factors for changing population were cited in this study? b. How did the natural factor cited in this study bring about the change? c. What other natural factors affect changes in population?	A. STUDY SC #12, p. 64. B. DISCUSS	A. STUDY B. DISCUSS TC #3, p. 129.	A. STUDY B. DISCUSS
Investigation #2: A. READ Have students read SC # 13 and determine what natural factors for affecting population change are described in the reading. B. DISCUSS Have class discuss reading and understand that natural factors still	A. READ SC #13, p. 68. B. DISCUSS	A. READ B. DISCUSS TC #3, p. 129.	A. READ B. DISCUSS

Inquiry Question:

VI. What are the natural factors causing change in the ecosystem and how have they been brought about?

Learning Activities	Resources	Evaluation	Teacher Suggestions
play a role in population control.			
C. VIEW/DISCUSS 1. Show SC #14 as a reminder of other "acts of God" that can affect population. 2. Have students summarize the various natural factors mentioned in these two Investigations.	C. VIEW/DISCUSS SC #14, p. 70.	C. VIEW/DISCUSS TC #3, p. 129.	C. VIEW/DISCUSS Remind students that even though natural factors are dramatic, the affect on population is minimal in comparison to worldwide population.
D. CHECK I. Q. Have students check results of their small group work.	D. CHECK I. Q.	D. CHECK I. Q. SC #1, p. 48. (I. Q. Check)	D. CHECK I. Q. Even though small groups were not used, SC #1 may be modified.
E. EVALUATE SELF Have students evaluate themselves.	E. EVALUATE SELF	E. EVALUATE SELF SC #2, p. 49.	E. EVALUATE SELF If Individual Point Sheets (I. P. S.) are to be used, reproduce sample form on page xiii of the Foreword and distribute to students.

Inquiry Question:

VII. What are the man-made factors causing change in the ecosystem and how have they been brought about?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1:			
A. PREDICT 1. Divide class into small groups. 2. Have each group predict an answer to this question: -What are some man-made factors that affect population change? 3. Make a list for class discussion.	A. PREDICT	A. PREDICT	A. PREDICT Remind students that population change can be a decrease as well as an increase.
B. COMBINE Through class discussion, combine each small group's list of predictions.	B. COMBINE	B. COMBINE TC #3, p. 129.	B. COMBINE
C. CHECK Read SC # 15 to verify the class's predictions.	C. CHECK SC # 15, p. 71.	C. CHECK	C. CHECK Have students review SC #10, p. 62, for other man-made factors.
D. REVIEW In class discussion, compare reading with class list and change if necessary.	D. REVIEW	D. REVIEW	D. REVIEW

Inquiry Question:

VII. What are the man-made factors causing change in the ecosystem and how have they been brought about?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #2			
A. RESEARCH Have students select one cause for decrease in death rate from SC #15 and do a short research paper on how this change was brought about.	A. RESEARCH 1. Allow ample time in school library. 2. Social Education, April, 1972. 3. "Population - the U. S. Problem the World Crisis," New York Times, April 30, 1972 (special supplement).	A. RESEARCH Collect final papers and evaluate.	A. RESEARCH
B. SUMMARIZE In class discussion, have students summarize how man-made factors affecting population change have been brought about.	B. SUMMARIZE	B. SUMMARIZE TC #3, p. 129.	B. SUMMARIZE
C. CHECK I. Q. Have students check results of their small group work.	C. CHECK I. Q.	C. CHECK I. Q. SC #1, p. 48.	C. CHECK I. Q. TC #2, p. 128.
D. EVALUATE SELF Have students evaluate themselves.	D. EVALUATE SELF	D. EVALUATE SELF SC #2, p. 49.	D. EVALUATE SELF If Individual Point Sheets (I. P. S.) are to be used, reproduce sample form on page xiii of the Foreword and distribute to student.

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Inquiry Question: VIII. What are the results of the changes?
A. Beneficial?
B. Detrimental?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1 A. COLLECT 1. Ask students to collect newspapers from their h· ..es for one week. 2. Weigh the collected papers at the end of a week and report the weight to class. B. COMPUTE Make a chart on the weight of paper by making the following computation and answering the questions: - What is the total of pounds of paper used per week by the class? - Total for school? (Multiply total of class by number of classes in school.) - How much paper is this per year for class? For school?	A. COLLECT B. COMPUTE	A. COLLECT B. COMPUTE Collect individual charts and evaluate.	A. COLLECT 1. This investigation is designed to emphasize the effect population has on natural resources. 2. We know that Americans throw away about one billion pounds of trash each day and about 14% of city trash is newspapers. Although paper is biodegradable, the sheer bulk of paper waste causes it to be classified as a serious solid-waste problem. B. COMPUTE

Inquiry Question: VIII. What are the results of the changes?
A. Beneficial?
B. Detrimental?

Learning Activities	Resources	Evaluation	Teacher Suggestions
C. DISCUSS 1. Have class discuss the results of their chart in relation to the following fact: - It takes about 17 trees to produce 1,000 pounds of newsprint. 2. How many trees were used to produce a newsprint for the class' families for one week? One year? 3. What can this investigation tell us about an increasing population and its demand for natural resources like: - energy - water - air	C. DISCUSS	C. DISCUSS TC #3, p. 129.	C. DISCUSS 1. Record any conclusions to discussion on chalkboard and have students keep for future reference. 2. Most students will realize that an increase in population will result in an increase demand for natural resources.
D. READ/REACT Have students read SC #16 and react to its meaning in class discussion.	D. READ/REACT SC #16, p. 73.	D. READ/REACT	D. READ/REACT

Inquiry Question: VIII. What are the results of the changes?
A. Beneficial?
B. Detrimental?

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #2			
A. READ/DISCUSS 1. Have all students read SC #17. 2. In class, discuss the meaning of "zero population growth" and the pros and cons of population increase as a problem.	A. READ/DISCUSS SC #17, p. 74.	A. READ/DISCUSS TC #3, p. 129.	A. READ/DISCUSS ZPG (SC #17) is a private organization that advocates and actively encourages a national zero birth rate. This rate would be at a "replacement level" and not an "increase level." Current population numbers would be replaced but there would be no increase in numbers of people. This would mean the average birth rate per woman would be 2.1 births.
B. PLAN DEBATE 1. Organize class to debate the following issue: "Resolved, human beings should be restricted to bearing or fathering two live children." a. Divide class into debate teams with half of the team taking the pro side of the issue and half the con side. b. Review guidelines for informal debating (see Teacher Suggestions #2). 2. Have teams read either SC #'s 18 and 19 (pro) or SC #'s 20, 21, 22, and 23 (con) as an introduction to each view.	B. PLAN DEBATE 1. Pro view, SC #'s 18 and 19, pp. 76-79. 2. Con view, SC #'s 20, 21, 22 and 23, pp. 81-95. 3. Ample time in library or homework time.	B. PLAN DEBATE	B. PLAN DEBATE 1. With a number of debate teams all students can participate in research. 2. Locate guidelines for informal debating in any textbook used for Spoken Arts' classes. One example is: Speak Up! Adams and Pollock MacMillan Company New York, NY pp. 238, 241, 245.

Inquiry Question: VIII. What are the results of the changes?
A. Beneficial?
B. Detrimental?

Learning Activities	Resources	Evaluation	Teacher Suggestions
3. Allow library time for teams to research their side of the Resolution and plan their notes for debate.			
C. CONDUCT DEBATES Have all teams present their debate to the class.	C. CONDUCT/ DEBATES	C. CONDUCT/ DEBATES 1. Student judges could be used to evaluate the actual debate. 2. Teachers of other subjects could be invited to judge the debate.	C. CONDUCT/DEBATE This series of debates may become repetitious in nature, therefore decide if entire class will actually perform or only selected teams. Teams could be numbered and selected by chance.
D. SUMMARIZE 1. In class discussion, following debates, have students decide on effects (beneficial/detrimental) of both increased or decreased population. 2. List results on chalkboard. 3. Make copy of final results.	D. SUMMARIZE	D. SUMMARIZE TC #3, p. 129.	D. SUMMARIZE
E. CHECK I. Q. Have students check results of their small group work.	E. CHECK I. Q.	E. CHECK I. Q. SC #1, p. 48.	E. CHECK I. Q. TC #2, p. 128, gives procedure for this check.
F. EVALUATE SELF Have students evaluate themselves.	E. EVALUATE SELF	E. EVALUATE SELF SC #2, p. 49.	E. EVALUATE SELF If Individual Point Sheets (I. P. S.) are to be used, reproduce sample form on page xiii of the Foreword and distribute to students.

LEARNING ACTIVITIES

Cause/Effect of Specific Changes

(Inquiry Questions VI — VIII)

WATER SUPPLY

Inquiry Question:

VI – VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1:			
A. READ Student will read SC #'s 24-27.	A. READ SC #'s 24-27, pp. 96-100.	A. READ	A. READ These resources will provide the student with statistical information designed to acquaint him with the importance of water to him. Initial reading of these may be perfunctory, student will use each in perusal of remainder of activities and will refer to these individually in some detail.
B. INVESTIGATE AND RECORD 1. Each student will investigate water use in his own home for one weekend, referring to SC #25. 2. Each student will record information on water usage in his home during the investigative period. Individually developed recording procedures will be used. Record must include number of residents, total amount of water used, and a breakdown of this total for variety of uses. 3. Record numbers on water meter early on first day of observation and late on second day.	B. INVESTIGATE AND RECORD SC #25, p. 97.	B. INVESTIGATE AND RECORD 1. Recording procedure developed by student. 2. Completeness, originality, detail, accuracy and neatness of record should be considered in evaluating.	B. INVESTIGATE AND RECORD 1. If water is metered, teacher may suggest that student read meter at beginning and end of each day. Encourage individuality of method. 2. Student may develop a variety of water-uses chart for his own home and maintain an inventory of use for the period of investigation. 3. Individual problems will be encountered. Students should be encouraged to seek cooperation and advice of their family in seeking

Inquiry Question: VI — VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
54			information and overcoming obstacles. 4. Teacher may suggest that students develop own methods to determine or estimate average amount of water used for each of a variety of common household activities such as: (a) Bath (b) Shower (c) Shampooing (d) Washing Dishes (e) Laundry (f) Brushing Teeth (g) Cooking Dinner (h) Making Coffee, Tea, etc. (i) Flushing Toilet (j) Watering Lawn
C. REPORT Each student's home research record will be made into final chart form for report to other students.	C. REPORT	C. REPORT Collect reports and evaluate.	C. REPORT
D. COMPUTE Students will use individual reports and arrive at an average amount of water consumption: a. per student b. per family c. per individual use listed.	D. COMPUTE Student Home Research Records	D. COMPUTE	D. COMPUTE Depending on class size, this may be a class activity or committee type activity.

Inquiry Question:
V – VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
E. DISCUSS Students will discuss, and compile a check-list of ways in which family water consumption may be diminished without appreciably affecting their present life-style.	E. DISCUSS	E. DISCUSS TC #3, p. 129.	E. DISCUSS
F. APPLY/EVALUATE/COMPARE 1. Each student will attempt to apply each suggestion from prepared check-list in his home for a period of time similar to that of his original home investigation. If unable, or it is not advisable to implement a suggestion, student will so indicate on check-list and indicate reasons. 2. Each student will maintain a record of water consumption during this period similar to that devised during original investigation and compare the water use: a. per student b. per family c. per individual use listed After application of student suggestions, compare with the same statistics prior to application.	F. APPLY/EVALUATE/COMPARE List of student suggestions.	A. APPLY/EVALUATE/COMPARE 1. Collect completed check-list. 2. Student record of water consumption.	A. APPLY/EVALUATE/COMPARE

Inquiry Question:

VI – VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
G. DISCUSS Each student will discuss the comparative water usage reports with their family to determine: a. whether they see any value in each applied water conservation device or procedure, b. which, if any, of the experimental procedures they would be willing to continue using, and c. any additional suggestions they have for home conservation of water which they might be willing to accept.	G. DISCUSS	G. DISCUSS	G. DISCUSS
H. REPORT/DISCUSS 1. Students will report results of family discussion to class. 2. Students will discuss overall merits of this investigation in arriving at solutions to Inquiry Question.	H. REPORT/DISCUSS	H. REPORT/DISCUSS Individual reports.	H. REPORT/DISCUSS

Inquiry Question:
VI – VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #2:			
A. READ/NOTE 1. Have students read SC #'s 28 and 29. 2. Note answers to Inquiry questions VI – VIII, as they apply to the news article events.	A. READ/NOTE SC #'s 28 and 29, pp. 101-103.	A. READ/NOTE Collect a copy of notes and evaluate.	A. READ/NOTE Help students with terms like: - FCD - Environmental impact studies - "Natural systems" - Impoundment area - River basin - Reservoirs
B. DISCUSS 1. In class, discuss answers to the above questions. 2. Reach a class consensus on the changes and results of the news-article events.	B. DISCUSS	B. DISCUSS TC #3, p. 129.	B. DISCUSS Have students keep a copy of consensus reached.
Investigation #3:			
A. PLAN FIELD TRIP 1. Make arrangements for a visit to a local water purification plant. 2. Before trip, divide class into small groups and have one member of group responsible for one question listed in SC #30 Ask plant operator the questions.	A. PLAN FIELD TRIP SC #30, p. 104.	A. PLAN FIELD TRIP	A. PLAN FIELD TRIP 1. When possible, allow students to make arrangements for contacting plant operator. 2. It may be wise to send a list of the questions (SC #30) to the plant operator before the scheduled visit.

Inquiry Question: VI – VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
3. Have students review and understand questions in SC #30.			
B. EXECUTE FIELD TRIP	B. EXECUTE FIELD TRIP	B. EXECUTE FIELD TRIP	B. EXECUTE FIELD TRIP
Have students observe and listen closely as their tour is conducted.			Remind students questions need not be limited to the ones in SC #30.
C. CONDUCT POST-TRIP ACTIVITIES	C. CONDUCT POST-TRIP ACTIVITIES	C. CONDUCT POST-TRIP ACTIVITIES	C. CONDUCT POST-TRIP ACTIVITIES
1. Have each small group compose a written report based on the answers to questions made on the trip. 2. In class discussion reach a consensus to each question.		1. Collect written report. 2. TC #3, p. 129.	
Investigation #4:			
A. REVIEW	A. REVIEW	A. REVIEW	A. REVIEW
1. Divide class into small groups. 2. Have each group review the results of Investigations 1, 2, and 3 and write out a general conclusion to each Inquiry Question, VI – VIII.		Collect a copy of the written conclusions.	
B. REPORT/DISCUSS	B. REPORT/DISCUSS	B. REPORT/DISCUSS	B. REPORT/DISCUSS
Have each group report to class and discuss the conclusions presented.		TC #3, p. 129.	

Inquiry Question:
VI — VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
C. CHECK I. Q. Have students check results of their small group work.	C. CHECK I. Q.	C. CHECK I. Q. SC #1, p. 48.	C. CHECK I. Q. TC #2, p. 128, gives procedure for this check.
D. EVALUATE SELF Have students evaluate themselves.	D. EVALUATE SELF	D. EVALUATE SELF SC #2, p. 49.	D. EVALUATE SELF If Individual Point Sheets (I. P. S.) are to be used, reproduce sample form on page xiii of the Foreword and distribute to students.

LEARNING ACTIVITIES

Cause/Effect of Specific Changes

(Inquiry Questions VI — VIII)

AIR POLLUTION

Inquiry Question:
VI – VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1			
A. READ Have students read SC #31 and 32 (background readings to point out air pollution problems of urban areas throughout the world).	A. READ SC #'s 31 and 32, pp. 105-109.	A. READ	A. READ TC #8, p. 134, gives a lengthy background on air pollution causes, costs, and controls.
B. ANSWER Have each student write answers to these questions concerning SC #'s 31 and 32: - What areas of the earth have the most serious air pollution problems? - What are the effects of air pollution? - What are the causes of air pollution (natural/man-made)?	B. ANSWER	B. ANSWER	B. ANSWER
C. DISCUSS In class, discuss final answers to reading questions.	C. DISCUSS	C. DISCUSS TC #3, p. 129.	C. DISCUSS
Investigation #2			
A. CONDUCT/DISCUSS 1. Have small groups conduct Experiment 1 in SC #33. 2. Discuss results of experiment.	A. CONDUCT/DISCUSS SC #33, p. 111.	A. CONDUCT/DISCUSS Collect written results of experiment.	A. CONDUCT/DISCUSS These experiments help students internalize the concepts of cause and effects of air pollution.

Inquiry Question: VI – VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
B. CONDUCT/DISCUSS 1. Conduct Experiment 2 in SC #34. 2. Discuss results of experiment.	B. CONDUCT/DISCUSS SC #34, p. 113.	B. CONDUCT/DISCUSS Collect written results of experiment.	B. CONDUCT/DISCUSS Display used filter papers on bulletin board.
C. CONDUCT/DISCUSS 1. Conduct Experiment 3 in SC #35. 2. Discuss results of experiment.	C. CONDUCT/DISCUSS SC #35, p. 114.	C. CONDUCT/DISCUSS	C. CONDUCT/DISCUSS A greater variety and number of sources can be measured if this is assigned as homework.
D. CONDUCT/DISCUSS 1. Conduct Experiment 4 in SC #36. 2. Results of this experiment will be discussed after Experiment 5 has been completed to allow time for observations.	D. CONDUCT/DISCUSS 1. SC #36, p. 116. 2. Paper or styrofoam cups, saran wrap, automobile, vacuum cleaner hose.	D. CONDUCT/DISCUSS Collect written results of experiment.	D. CONDUCT/DISCUSS
E. CONDUCT/DISCUSS 1. Conduct Experiment 5 in SC #37. 2. Discuss results of Experiment. 3. Return to Experiment 4 and discuss its results.	E. CONDUCT/DISCUSS SC #37, p. 117.	E. CONDUCT/DISCUSS	E. CONDUCT/DISCUSS 1. Relate Experiments to the Inquiry Questions VI, VII, and VIII. 2. TC #10, p. 154, gives information on temperature inversions.

Inquiry Question:
VI – VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #3: A. VIEW 1. Tell students they are: a. to see a filmstrip on air pollution b. to answer these questions: -What are the major air pollutants? -What are the effects of air pollution? -What are methods of combating or controlling air pollution? 2. Show filmstrip.	A. VIEW 1. Sound filmstrip - Pollution: Our Air. 2. Filmstrip can be purchased from: Coronet Filmstrip 65 E. South Water Street Chicago, Ill 60601	A. VIEW	A. VIEW Any film or sound filmstrip that can answer these questions could be used.
B. DISCUSS Following the filmstrip, have the class discuss the answer to each of the questions and record on chalkboard.	B. DISCUSS	B. DISCUSS	B. DISCUSS Have students make copy of answers.
Investigation #4: A. SUMMARIZE Tell students they are to: a. make a collage which identifies each of the following: - a pollutant - the pollutant's major source - the pollutant's effect on the environment	A. SUMMARIZE Magazines, newspapers, pictures to be cut up for collage.	A. SUMMARIZE 1. Collect collages. 2. Maybe students could evaluate each other's work, using TC #5, p. 131. as guidelines.	A. SUMMARIZE Display collages on bulletin board.

Inquiry Question: VI – VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
b. review the last three Investigations for the needed information.			
B. PRESENT After making the collage, have each student present to the class and explain his work.	B. PRESENT	B. PRESENT Evaluate each oral presentation (TC #6, p. 132).	B. PRESENT
Investigation #5			
A. LIST/COMPARE 1. Have each student list ways he may personally be contributing to air pollution. 2. Divide class into small groups and have group members compare lists and compile one list for the group.	A. LIST/COMPARE	A. LIST/COMPARE Credit may be given for appropriate lists.	A. LIST/COMPARE
B. REPORT/DISCUSS 1. Each group reports its list to the class and a composite list is made. 2. Have class discuss ways individuals can help prevent or control pollution. 3. Complete a list of preventions on chalkboard.	B. REPORT/DISCUSS	B. REPORT/DISCUSS TC #3, p. 129.	B. REPORT/DISCUSS
C. COMPARE Have students review SC #38 and compare with the class composed list of preventions.	C. COMPARE SC #38, p. 120.	C. COMPARE	C. COMPARE

Inquiry Question: VI – VIII

Learning Activities	Resources	Evaluation	Teacher Suggestions
D. CHOOSE/REPORT 1. Encourage each student to choose 10 ways from either list in which he personally will make an effort to improve the quality of the environment. 2. Report choices to class.	D. CHOOSE/ REPORT	D. CHOOSE/ REPORT	D. CHOOSE/REPORT It may be of interest to students to have "progress reports" for a few weeks or months as to their efforts to personally improve the quality of the environment.
E. CHECK I. Q. Have students check results of their small group work.	E. CHECK I. Q.	E. CHECK I. Q. SC # 1, p. 48.	E. CHECK I. Q. TC #2, p. 128, gives procedure for this check.
F. EVALUATE SELF Have students evaluate themselves.	F. EVALUATE SELF	F. EVALUATE SELF SC #2, p. 49.	F. EVALUATE SELF If Individual Point Sheets (I. P. S.) are to be used, reproduce sample form on page xiii of the Foreword and distribute to students.

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LEARNING ACTIVITIES

Conclusion

(Inquiry Questions IX – X)

Inquiry Question:

IX — X

Learning Activities	Resources	Evaluation	Teacher Suggestions
Investigation #1 A. REVIEW/SUGGEST 1. Divide class into small groups and assign one of the following city problems to various groups: - population - water supply - air pollution 2. Have each group review the results of the previous Investigations relating to their assigned city problem. 3. Have each group discuss and suggest answers to these two questions. - What new changes are needed to help solve the city problem? - How are these proposed solutions to be brought about?	A. REVIEW/SUGGEST	A. REVIEW/SUGGEST	A. REVIEW/SUGGEST
B. RESEARCH 1. Allow library time for groups to locate a variety of proposed solutions to their problems and ways solutions can be brought about. 2. Have students collect newspaper and magazine articles relating to their city problem. SC #39 is a sample.	B. RESEARCH SC #39, p. 125.	B. RESEARCH Evaluate the collection of material.	B. RESEARCH TC #'s 11 and 12, pp. 155-156, give some background into solutions to population problems.

Inquiry Question:

IX – X

Learning Activities	Resources	Evaluation	Teacher Suggestions
3. Encourage students to watch for television specials on their problem.			
C. SPECIFY 1. Suggest in detail how solutions can be brought about. 2. Describe the specific role of individuals, groups (non-governmental), and government, in solving problems.	C. SPECIFY	C. SPECIFY	C. SPECIFY Remind students they have a personal responsibility for contributing to solutions.
D. PLAN 1. Have each group plan a presentation of their studies on solutions. 2. Students may select one of the following media or use one not listed: - poem - letter to newspaper editor - script for a special television show - short story - song - play - series of public service commercials - collage - poster or chart - series of political cartoons - series of drawings - series of billboard advertisements	D. PLAN	D. PLAN Collect written work related to presentation.	D. PLAN

Inquiry Question: IX – X

Learning Activities	Resources	Evaluation	Teacher Suggestions
E. PRESENT Upon completion of planning, groups should present their results to the class.	E. PRESENT	E. PRESENT Presentations may be judged by the entire class.	E. PRESENT
F. DISCUSS 1. After each presentation, allow class to discuss ideas given. 2. After all presentations, decide upon a consensus to each problem solution and how it could be brought about. 3. List consensus on chalkboard.	F. DISCUSS	F. DISCUSS TC #3, p. 129.	F. DISCUSS
Investigation #2			
A. DESIGN 1. Divide class into small group. 2. Have each group, using the list of solutions for the previously identified city problems and problems not yet discussed, plan an ideal city in which these problems have been solved. 3. Describe how each problem will be solved by graphically depicting an ideal city. Written commentary should accompany sketches of ideal city to explain how problems are solved.	A. DESIGN	A. DESIGN	A. DESIGN Encourage students to be as creative as possible in this project. Allow reasonable time for this creativity.

Inquiry Question:

IX – X

Learning Activities	Resources	Evaluation	Teacher Suggestions
B. DISPLAY 1. Each group will plan how it will display its concept of the ideal city. 2. After displays are established, allow students to inspect other displays.	B. DISPLAY	B. DISPLAY Use a form like SC #5, p. 131, and allow students to judge the displays.	B. DISPLAY
C. VIEW/DISCUSS 1. Have students see filmstrip and watch for ways man has attempted to solve some city problems. 2. After filmstrip, discuss reactions to solutions and compare with their own answers used in their ideal city.	C. VIEW/DISCUSS 1. Urban Civilization, Part III. 2. Filmstrip may be purchased from: Educational Audio Visual, Inc. Pleasantville Illinois 10507	C. VIEW/DISCUSS TC #3, p. 129.	C. VIEW/DISCUSS Any filmstrip describing attempted solutions to city problems may be shown.
D. CHECK I. Q. Have students check results of their small group work.	D. CHECK I. Q.	D. CHECK I. Q. SC #1, p. 48.	D. CHECK I. Q. TC #2, p. 128, gives procedure for this check.
E. EVALUATE SELF Have students evaluate themselves.	E. EVALUATE SELF	E. EVALUATE SELF SC #2, p. 49.	E. EVALUATE SELF If Individual Point Sheets (I. P. S.) are to be used, reproduce sample from on page xiii of the Foreword and distribute to students

STUDENT COMMENTS

STUDENT COMMENT NO. 1 : Small Group Evaluation

I. Q. (INQUIRY QUESTION) CHECK

Name _____ Group Number _____ Class Period _____ Date _____

Inquiry Question
Being Investigated: _____

My Answer to
this Inquiry Question: _____

_____

Important parts of this
Inquiry Question Answer
Left Out: _____

Points Possible for
this Inquiry Question _____

Points Awarded for
this Inquiry Question _____

Name of Checker _____

STUDENT COMMENT NO. 2 : Self-Evaluation

SELF-EVALUATION FORM

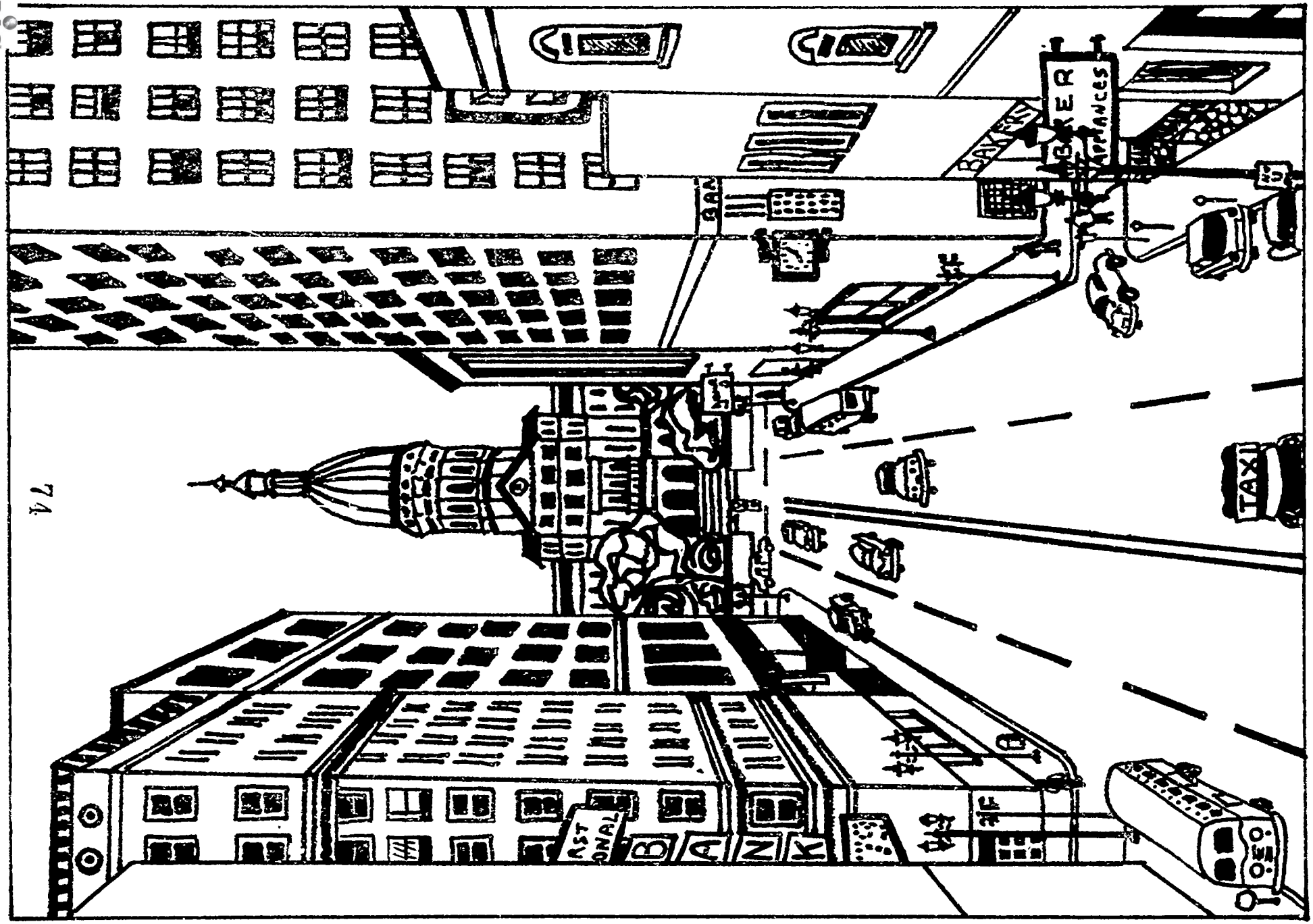
Name_____ Period_____ Date_____

Directions: When you have completed all work on an Inquiry Question, use the Point Scale below and rate yourself on each of the categories listed in the chart.

Point Scale: 5 points — excellent; 4 points — above average; 3 points — average; 2 points — below average; 1 point — poor

CATEGORIES	INQUIRY QUESTION NUMBERS									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Interest (To what degree were you interested in this Inquiry Question?)										
Understanding (To what degree do you feel you understand the conclusion to the Inquiry Question?)										
Effort (To what degree did you do all activities to the best of your ability?)										
Cooperative Participation (To what degree did you contribute useful ideas in solving group problems and/or help others reach a conclusion about this Inquiry Question?)										
Total Points										

STUDENT COMMENT NO. 3



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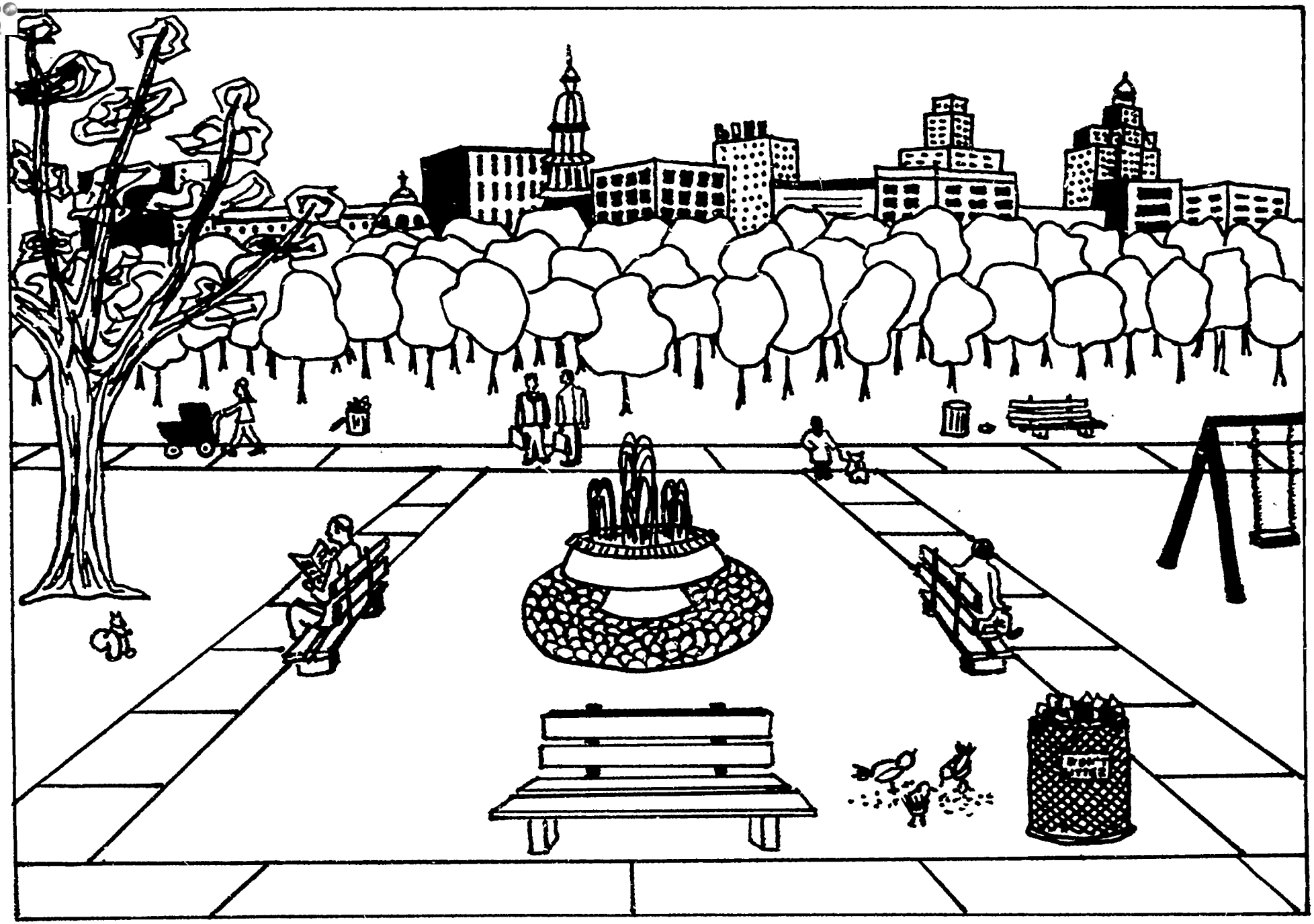
STUDENT COMMENT NO. 4



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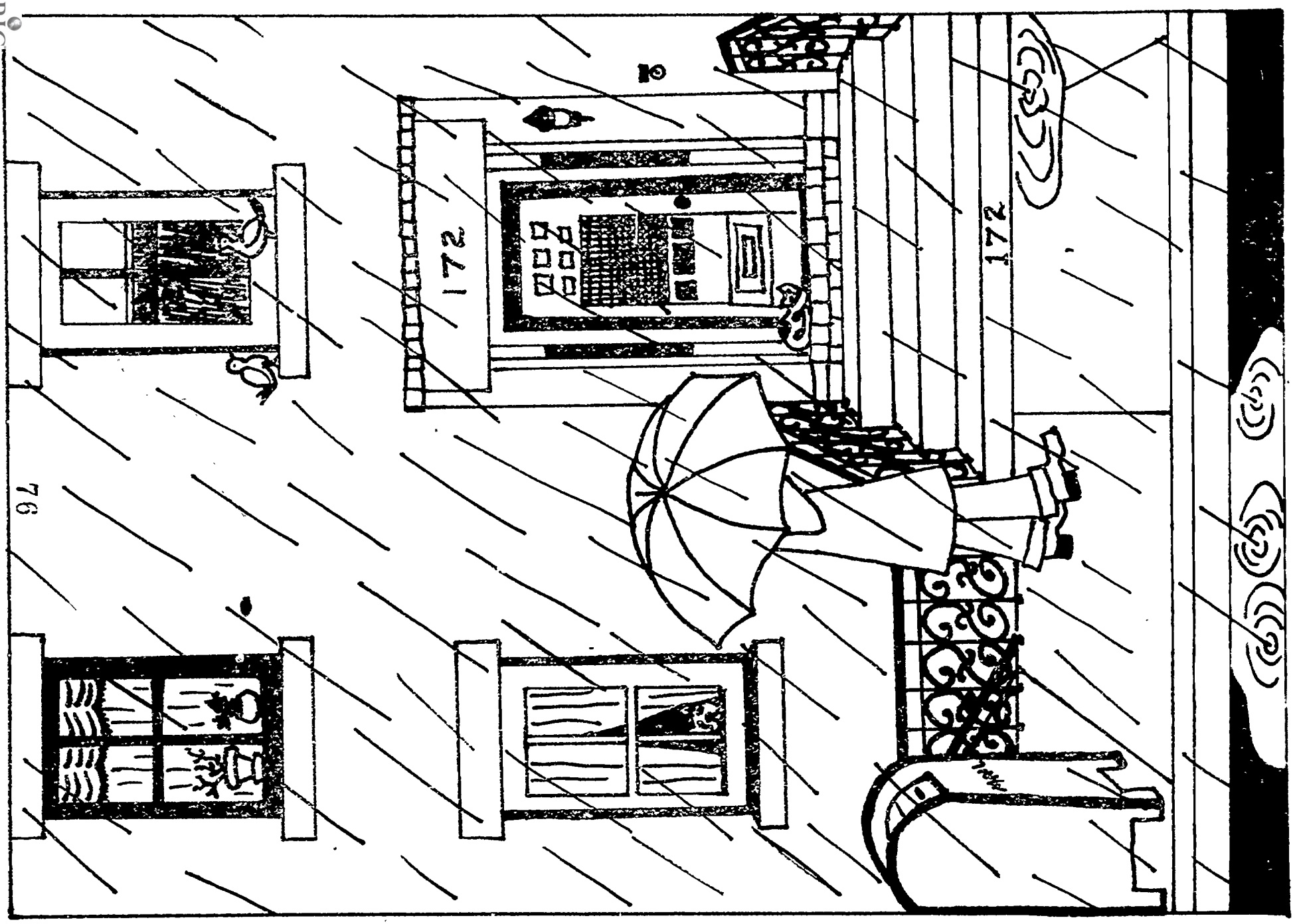


STUDENT COMMENT NO. 4: Some Things That Share the City With Man

All cities are alike in the way they destroy nature. Even one human on 1, 200 acres will have some effects on the plants and animals that share the land with him. He must kill some animals and plants for food. He may kill or hurt many more by accident. But imagine how 50, 000 people would affect the plants and animals that live on the same 1, 200 acres!

When people build cities, they kill nearly all the plants and drive out nearly all the wild animals that live on the land. The soil itself is covered with buildings and streets. Some of earth's cities have set aside land for parks. Everyone agrees that it is wonderful to have a patch of green trees and grass growing inside the city. And yet, the parks slowly fill up. Streets and highways are built through them. Restaurants, zoos, museums, tennis courts, police stations, playgrounds, bicycle paths, horse-back riding trails, amusement parks, swimming pools, skating rinks, theatres, plazas, fountains, and statues slowly cover the open space. Of course, these are all good things to have in the city. But why must they take the place of trees and grass?

When man finishes his cities, only four kinds of things live there with him. The first, and rarest, are birds, squirrels, and other animals that live in the tiny green patches left inside the city.

The second are pets, houseplants, trees, shrubs, and flowers that man brings into the city to share his life.

The third are the pests that live in the city, whether man wants them or not. These include rats, mice, and a few kinds of birds and bugs.

Finally, the city is full of the tiny things like bacteria and viruses that live on and in the human body. Of course, these little things live with man whether he is in the city or not and sometimes cause a lot of trouble when people live crowded together.

McCue, George, Ecology: The City, pp. 10-11, Benziger Inc., New York: Beverly Hills, 1971.

STUDENT COMMENT NO. 5: Little Things That Make Man Their Home

Every human being is a home for many small living things. People some times have fleas and lice living in their hair. Millions of people have tiny animals called mites living in their eyelashes. You can't see the mites, and usually they don't cause any trouble, but they are there. Many kinds of colorless plants called fungi live on the skin and in the body. Worms and other tiny animals live inside people; and the skin, mouth, intestines, and many other parts of man are a home for bacteria and viruses. The human body supplies these things with food, water, and warmth - as well as a free ride.

Not every person has the same kinds of things living on him. As a matter of fact, each person has his own special community. It is often hard for anything new to find a spot to grow on. But before you start scratching or run home to take a bath, remember these things: first of all, most of the things that live on man cause very little trouble. And second, a person may carry a disease without being sick. For example, the person may be immune because he has already had the disease. Or maybe the person has had shots or has been vaccinated against the disease.

When people get close together, these little visitors have a chance to move from one person to another. For example, some bacteria and viruses float through the air on drops of water caused by coughing, sneezing, or spitting. Others ride from person to person on tiny flakes of dry skin. One can never be sure what he is picking up from other people.

Because they bring many people close together, cities are an important cause of the spread of disease. That does not mean that disease would disappear if cities were torn down. But many diseases would be much less common.

McCue, George, Ecology: The City, pp. 12-13, Benziger Inc., New York: Beverly Hills, 1971.

STUDENT COMMENT NO. 6: How Cities Make Their Own Weather

Air pollution can cut down on the amount of sunlight that reaches a city. And often drops of water collect around the bits of dirt floating in the air. As a result, a city has more dark and foggy days than the country around it. But this is only one way that a city changes its own weather.

If you listen to weather reports, you know the temperature in the city is usually different from the temperature in the suburbs a few miles away. The buildings and the streets soak up heat from the sun and stay hot all night. Air-conditioners pour hot air into the city streets. As a result, cities are hotter during the summer days and nights than the country around them. In the winter also, the streets and buildings soak up heat from the sun. And the buildings are heated inside. This keeps the city warmer than the country in the winter.

The warmth of the city also cuts down on the number of days northern cities have snow. And plants may have three or four weeks longer to grow. In New York City, flowers may still bloom in window boxes at Thanksgiving time. A few miles away in New Jersey, frost may have killed the same kinds of flowers a month or more earlier.

A city also may have more rain than the country around it. The hot air over the city rises, pushing rain clouds higher into the sky. As the rain clouds rise, they cool off. And the more they cool off, the more water they drop.

McCue, George, Ecology: The City, pp. 32-33, Benziger Inc., New York: Beverly Hills, 1971.

STUDENT COMMENT NO. 7: Environmental Quiz - Part I

1. What is the daily use of water per capita for the USA?

   a) 5 gallons
   b) 50 gallons
   c) 150 gallons
   d) 300 gallons

2. How many pounds of solid waste are produced by the average US citizen each day?

   a) 2
   b) 4
   c) 6
   d) 10

3. Is it possible to re-cycle water so that it may be used and re-used indefinitely?

   a) Yes
   b) No

4. What is the annual value of reusable materials disposed of in the garbage of a city of 100,000 people?

   a) $10,000
   b) $100,000
   c) $400,000
   d) $700,000

5. When raw sewage enters a sewage treatment plant, what proportion of it is water?

   a) less then 50%
   b) 75%
   c) 90%
   d) more than 95%

6. One of the air pollutants generated by a coal fired power plant is:

   a) Nitrogen
   b) Methane
   c) Sulphuric acid mist
   d) Ozone

7. How efficient is a power plant? That is, what percentage of the energy if consumes is turned into electrical power?

   a) 20%
   b) 35%
   c) 50%
   d) 75%

8. Was the water used to make your morning coffee ever in someone's toilet?

   a) no
   b) probably not
   c) probably yes
   d) definitely yes

9. What is the population density of New York City, expressed as people per square mile?

   a) 5,000
   b) 10,000
   c) 25,000
   d) 50,000

10. The threshold of pain is 120 decibels. What is the decibel rating of the noise heard by a person sitting in the last seat of a jet aircraft?

    a) 50
    b) 80
    c) 110
    d) 130

Answers to Environmental Quiz - Part II

1. C. 150 gallons. This is a national average for every man, woman and child in the USA. It includes water used for drinking, bathing, agriculture and industry. Remember, your demands for material possessions puts additional demands on the water supply.

2. C. 6 pounds. This includes kitchen wastes as well as all other forms of solid waste. This figure has been increasing rapidly over the past few years because of changes in the packaging of products. For example, a trip to the grocery store for a package of frozen peas may result in 4 oz. of peas in a cardboard box, wrapped in wax paper, wrapped in a printed cover, put into a freezer bag and then into a paper bag. You take home 4 oz. of peas and 2 pounds of paper!

3. A. Yes. We have a finite amount of water on this planet and it has been recycling in the hydrological cycle for millions of years.

4. C. $400,000. This is the value of all the materials the city would throw away. Of course, the problem is how to reclaim it.

5. D. More than 95% pure. In fact, raw sewage entering a plant is between 99.5 and 99.8% pure water, the remainder is the amount of organic waste added by the community. As you can see, we are asking our treatment plants to operate on a very efficient basis. Those who suggest that the plants ought to be more efficient simply don't understand what they are asking.

6. C. Sulphuric acid mist. Remember your elementary chemistry? Coal contains sulphur as an impurity. Combustion produces water vapor and oxidizes the sulphur. Now we have sulphur dioxide (SO_2) and water (H_2O), together we get H_2SO_4. This wonderful product does great things to paint, rubber tires and women's nylon stockings!

7. B. 35%. The level of efficiency is governed by the laws of thermodynamics. No plant can be 100% efficient and the wasted energy is rejected from the process in the form of waste heat, gases, etc. These escape to the atmosphere or into lakes and streams. Nuclear and fossil fuel power plants have approximately the same levels of efficiency.

8. C. Probably yes. Refer to number 3 above. We have only so much water on this planet and there is no way to tell where it was before it got to us this morning.

9. D. 25,000. Population density is related to environmental quality. New York City has an extremely high population density and has its associated problems of air pollution, solid waste disposal, lack of water, lack of recreational space, etc.

10. C. 110. Airplane engines are notorious sources of noise pollution. Ask anyone who lives in a flight path! A recently passed federal law makes it illigal to have "continuous" noise levels above 85 decibels. Consequently, industries all over the US are trying to make things quieter for us.

STUDENT COMMENT NO. 8 : Changes in the City Environment

We said before that the city is your environment. All the buildings, cars, trucks and other people are part of it. The air, water, other animals, sunshine, and plants are also parts of it. These last parts were not made by people. They are part of the NATURAL ENVIRONMENT, because they come from nature. Cities change the natural environment. If lots of people walk on a street every day, there has to be a hard covering that won't wear out for a long time. That means there will be less soil for plants to grow in. And so there will not be as many plants. Our oxygen will have to blow over to us from other parts of the country, where there are more plants.

Cities change the natural environment in other ways too. Tall buildings cut down on sunlight. They change the climate. Where you see a twenty-story building now, perhaps there once was a pond. Instead of a woodchuck hole under the ground, there are telephone wires and water pipes. Other animals that need a large habitat have moved away because people took up more and more of the room they needed.

These are some of the changes man has made in the natural environment. The changes have made life easy for people in some ways. It is easier to buy food in a store than to hunt or grow your own. You keep warmer in a house with a furnace than in a house with only a fireplace. You can get water from the sink. Before the city was here, people had to get it from a well.

There are other changes that cities have made on the natural environment. These changes make life harder and not as pleasant. Because there are so many people in a city, there have to be a great many furnaces to keep them warm. One furnace pouring smoke into the air isn't too bad. But when there are hundreds, it makes the air dirty. The air is less healthy and makes clothes and paint dirty, too.

Getting rid of garbage is also a real problem in crowded cities. People have to get it out of their homes. Garbage men have to get it out of the cans in the street. And then it has to be put someplace away from people.

Too often the waste from houses and factories are thrown into the river. This makes the water not fit to drink. The dirty water kills the fish and other animals which live in clean rivers and lakes. You cannot go fishing because there are no fish. Some rivers are so dirty that people cannot go swimming in them. They might get sick from the dirty water.

This kind of man-made dirt in air and water is called POLLUTION. Another kind of man-made dirt is called litter. One small candy paper on the sidewalk may not be so bad. When hundreds of people throw small pieces of paper on the ground it makes a big mess.

Noise can be another bother. Noise doesn't do anything to air, water, food and shelter but it does something to you.

In the city you hear noise from trucks, cars, buses, trains, air hammers, horns, garbage cans, airplanes, and many other things. All this noise can make you feel mad or restless and uncomfortable. Too much noise is not good for anybody.

A Place to Live. Published by the National Audubon Society, 1130 Fifth Avenue, New York, N. Y. 10028.

STUDENT COMMENT NO. 9 : Population Distribution

It is possible to drive through large empty stretches in this country and wonder if those who talk of "population problems" aren't exaggerating. The trouble is that over 70 percent of our population is now concentrated in urban areas. This figure is likely to increase to 85 percent by the year 2000.

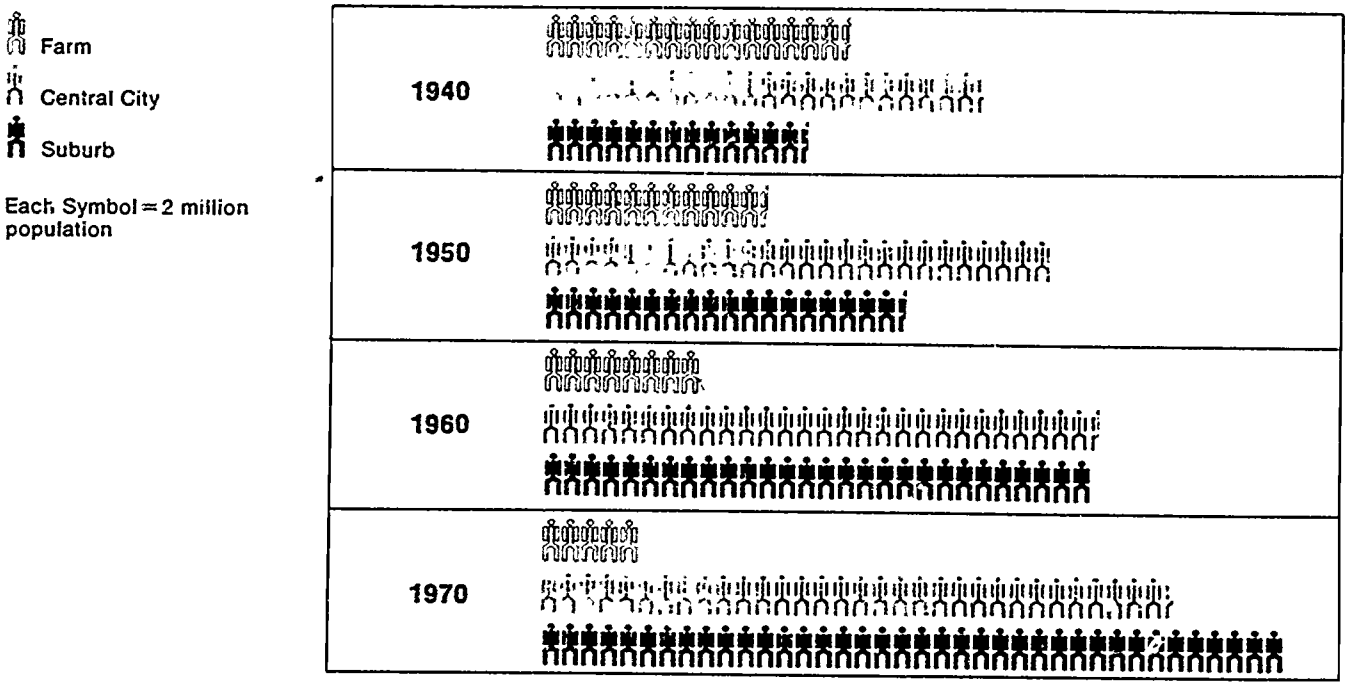
Patterns of population distribution are complex: people move from rural to urban areas, from urban areas to the suburbs, and from city to city. This creates problems. The problems result from the rate of change as much as from changes in absolute size. Consider some examples:

- The growth of the suburbs has taken the richer population away from the inner cities. Stores and businesses have followed the wealthy to the suburbs, taking jobs with them. Who have been left behind? The unskilled and the poor. Not only has this strengthened already established patterns of segregation, but the central city must now bear increased responsibility for the social and financial problems of the disadvantaged at a time when the tax base and resulting revenues have declined.

- Many small towns and rural areas have lost people. In the last few decades nearly half of the 3,000 U.S. counties have lost population. Most of these counties are in the area between the Mississippi and the Rocky Mountains, from the Canadian border to the Rio Grande, and in the Appalachian Mountains. These regions have been left with a concentration of old people who need social services, yet whose incomes are low. As the communities shrink, they lost the tax base needed to finance the services. The result has often been a deterioration of living conditions and further economic decline for the community. This in turn stimulates more outward movement as the young and better educated go to seek their fortunes in the big cities.

Even if the population of our country were to stop growing, we would still have problems associated with rural depopulation and metropolitan growth. Because natural increase (the excess of births over deaths) accounts for 75 percent of current metropolitan growth, it may be that the most effective long-term strategy for reducing local growth will be through reducing the growth of the national population rather than redistributing it.

FARM, CITY, AND SUBURBAN POPULATION, 1940-1970



Source: U.S. Bureau of the Census, Census of Population and Housing: 1970, *General Demographic Trends for Metropolitan Areas, 1960-1970*, PHC(2)-1 (1971).

Options - A Study Guide to Population and the American Future, Produced by the Population Reference Bureau, Inc., 1973, pp. 12-13.

STUDENT COMMENT NO. 10

U.S. Birth Rate Starts to Dwindle

TODAY Wire Service

PRINCETON, N.J. — There has been a dramatic decline since 1967 in the proportion of Americans who favor large families, according to a recent survey. The number is now at the lowest point in the 37 years during which surveys have been regularly conducted on the subject.

The latest survey results appeared in a copyright story by Field Enterprises, Inc. and included the fact that only one adult in five (20 percent) considers the ideal number of children in a family to be four or more. Only six years ago, the percentage was double that figure.

For the first time in four decades of polling history, Protestants and Catholics hold similar views on the ideal number of children in a family. In the latest survey, 20 percent of Protestants compared to 23 percent of Catholics say the ideal number of children is four or more.

In 1967, 37 percent of Protestants said "four or more" is the ideal number, but a considerably higher percentage of Catholics, 50 percent, held this opinion, the survey pointed out.

Today, February 8, 1973

Government population data indicate that young American women — rich and poor alike — are having fewer children than at any time in the nation's history. According to a recent government report, the U.S. fertility rate for the first nine months of 1972 dropped below zero population growth for the first time.

If the birth rate stayed at or below the present level and there were no significant immigration, the U.S. population would level off sometime after the year 2000. However, because many factors are involved, it is impossible to make firm predictions.

Various factors have been cited as contributing to a dwindling birth rate, including the cost of living (particularly the cost of education), widespread use of contraceptives, concern over crowded conditions and overpopulation, more liberal abortion laws and more abortions, and perhaps changing values and lifestyles as reflected by women's liberation.

The decline since the 1967 Gallup survey in the percentage favoring large families has come among all major population groups, but it has been most pronounced among women, Catholics, younger adults and persons with a college or high school background, according to the survey.

In 1967 women were far more inclined than men to favor large families, but today little difference is found in the opinions of the two sexes.

The trend reported today is of considerable significance in terms of expected population growth.

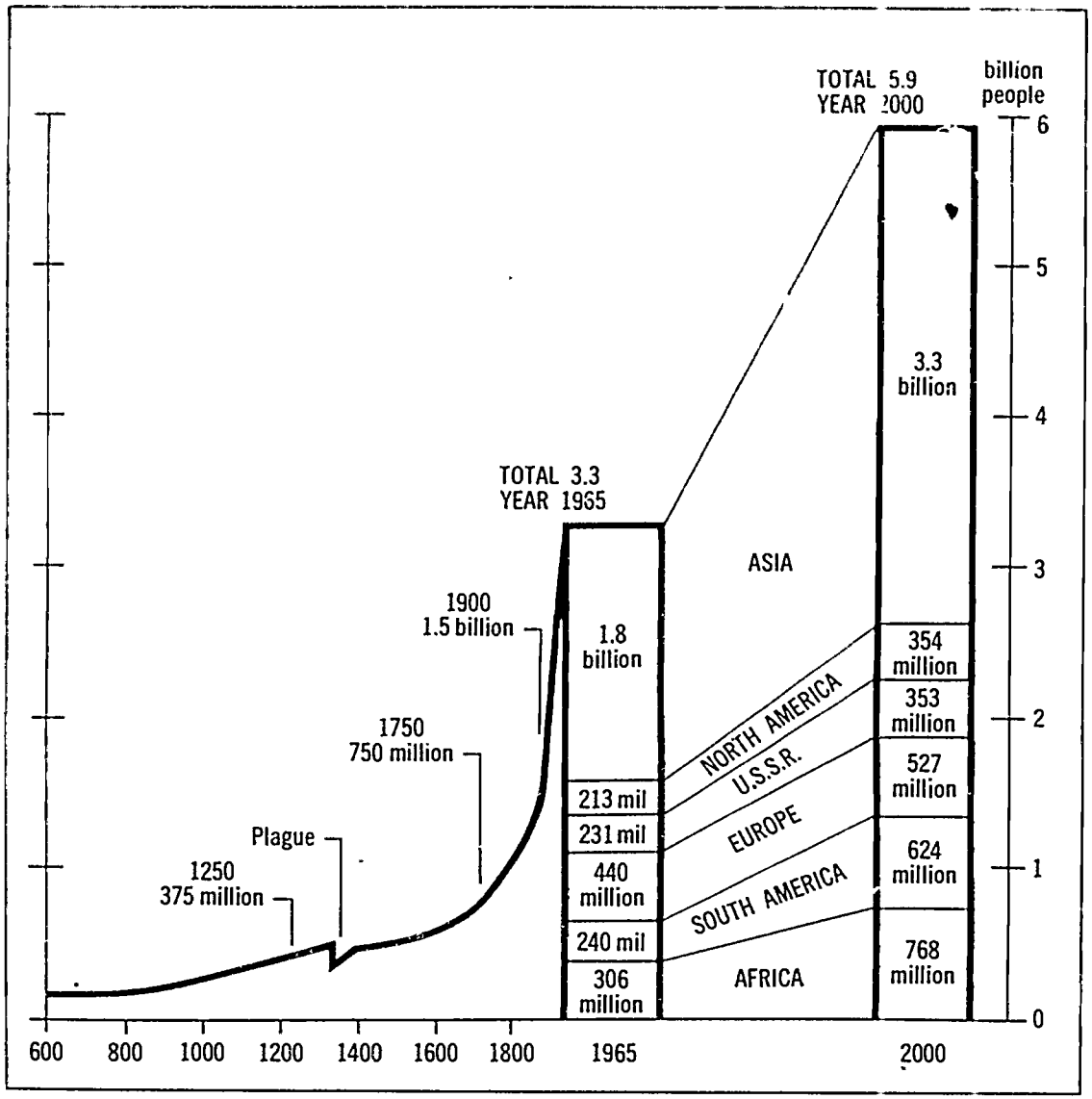
The following table shows what Americans currently believe to be the ideal number of children to have.

It shows the change in views between 1967 and today by key population groups:

PERCENT SAYING 4 OR MORE IS IDEAL NUMBER OF CHILDREN

	1967	1973	Point Change
NATIONAL	40%	20%	-20
Men	34	18	-16
Women	45	21	-24
Under 30 years	34	12	-22
30 to 49 years	40	22	-18
50 and over	42	24	-18
Protestants	37	20	-17
Roman Catholics	50	23	-27
College	34	12	-22
High school	40	19	-21
Grade school	44	31	-13

STUDENT COMMENT NO. 11: World Population Growth



Source: Southern Illinois University, World Resources Inventory, *World Design Science Decade, 1965-1975, Phase I, 1965, Document for the 10-Year Program* (John McHale), Carbondale, Southern Illinois University, 1965, p. 8.

STUDENT COMMENT NO. 12: **The Black Death**

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The Honorable Doctor Eric Robinson
Maleren Road, Staden isl.
Stockholm, Sweden *10 April, 1351*

We set sail from Naples, Italy, five days ago and are en route to Barcelona, Spain. Winds are light and the weather is good. So with time to spare, I shall undertake to keep my promise to you and put my log notes in some order. Perhaps then you may make some sense of the horrible pestilence that has demolished the people of Europe and stolen so many of our dearest ones.

When we reached Marseilles, France, over three years ago in late 1347, the plague had already arrived there. The people suspected it had come by ship from Genoa. The Genoan merchant marine may have brought the disease from Kaffa, a Genoan colony on the Black Sea. Kaffa had been besieged by the Tartars. But the Tartars were finally forced to give up the siege because so many of their forces were lost to the pestilence. Before they departed, the Tartars catapulted bodies of their dead warriors into the city, hoping to spread the death among the citizens. They believed the pestilence could be transmitted from the dead to the living.

It is believed that when the Genoan sailors returned home, they brought the disease with them. It is also rumored that in addition to the disease, they brought a large number of black rats that had stowed away while their ships had been docked at Kaffa. Upon reaching the port of Genoa, the disease and, of course, the rats spread into the city.

Soon the blight spread to Marseilles. No one knew how for sure, perhaps by ship again. Some said it was spread by the miasma, or poison cloud. Corrupted air, damp mists, hot south winds have all been suspected of carrying the pestilence. Earthquakes, fire pillars, and other mysterious occurrences are considered by some to be the cause of the plague. While in Venice, a few months ago, I heard that the Venetians had received an omen of the coming plague. Just before the disease appeared in the city, an earthquake occurred and the bells in St. Mark's rang out without being touched by human hands.

Astrologers in Paris blame the catastrophe on the conjunction of Saturn, Jupiter, and Mars in the house of Aquarius. Other Parisians believed the pestilence to have been caused by a ball of fire seen above the city.

I'm sure that you, with your scientific knowledge, will be able to decide which, if any, of these explanations is best. Whatever the cause, the people I've seen all around Europe seem resigned to their fate. They agree that the pestilence is the will of God. They are sure their sins have brought this punishment upon them.

As you know, millions have died in the three years since 1347. I need not report the horrible nature of the disease. You know it too well. But how it passes from person to person is still a mystery. Some say it is by breath; others claim only a look is necessary. Just by touch it spreads, according to one theory. Some even believe it is foul air bottled up in vessels. It is said that these vessels are carried by evil men to a place upwind from a city. Then their foul contents are released and the fumes spread over the town.

It is almost unbelievable how many have died the horrible death of bursting boils and blistering fever. No one is certain of the count. It is estimated that, within six months, Florence lost 55,000 of its 90,000 inhabitants. The reports I have heard from all over Italy suggest that up to 60% of the population perished. Apparently, the same horror abounded in other countries. All in all, more than 30% of the population of Europe have died. The heaviest toll reported is among the clergy—around 50%. Some monasteries have been completely wiped out.

But my promise was to help you chart the spread of the plague. I have tabulated what figures I could get in the enclosed logs. All dates are approximate. The cities have been identified according to the six-month period during which the disease fell upon the inhabitants. I trust this will help you in your research.

May God live with you each day.
Your friend and brother,

Swen

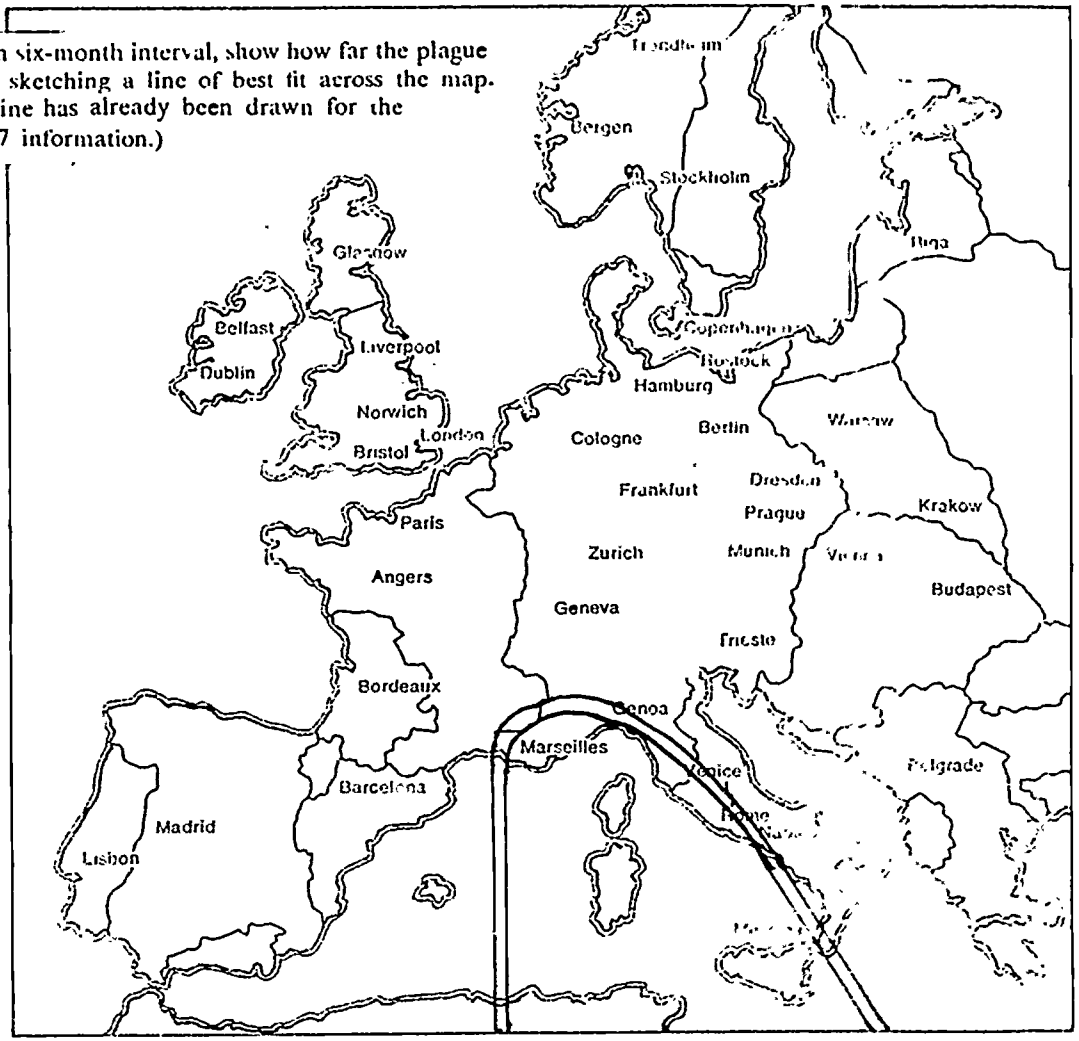
The plague described briefly in this letter is perhaps the greatest environmental crisis ever to strike Europe. Later to be called the Black Death, it originated in Asia. It was not the only plague to strike. There were many before and several to follow. However, the Black Death of the fourteenth century took a dreadful toll. Nearly thirty million Europeans died.

The log referred to in the letter follows in Table 1-1. Assume that you are the physician receiving these data. Use the data to chart the movement of the Black Death across Europe. (The names used in the log, as well as many in the letter, have been modernized so that they are the ones most familiar to you.)

Month and Year	New Cities Affected
December, 1347	Genoa, Marseilles, Messina, Naples, Rome
June, 1348	Angers, Belgrade, Bordeaux, Geneva, Madrid, Paris, Trieste, Venice
December, 1348	Bristol, Budapest, Lisbon, London, Munich, Vienna, Zurich
June, 1349	Cologne, Dublin, Frankfurt, Liverpool, Krakow, Norwich, Prague
December, 1349	Belfast, Bergen, Berlin, Dresden, Glasgow, Hamburg
June, 1350	North of Bergen, Copenhagen, Rostock, Warsaw
December, 1350	South of Riga, Stockholm, North of Trondheim

Table 1-1

□1-1. For each six-month interval, show how far the plague had spread by sketching a line of best fit across the map. (Notice that a line has already been drawn for the December 1347 information.)



The steady march of the plague across Europe represented a great catastrophe for the people. Many countries were overpopulated, and great crop failures had brought these nations to their knees. Now a killing blow was dealt by disease. The suffering people believed their folly and sin had brought disaster down upon them. And they were not entirely wrong. Overpopulation in certain areas had produced overcrowded and unhealthy living conditions. Careless piling of rubbish provided food for increasing numbers of rats and other vermin. The people had misused their environment. They did not understand that the environment cannot be misused indefinitely.

Since the fourteenth century, man has learned to control the spread of the plague by using special drugs and vaccines. However, man has much to learn about his environment. He is just beginning to see that his living habits can make this world unsafe and unfit for life.

A Real Killer

The Black Death, now called *bubonic plague*, is a disease spread by fleas infected with the bacteria *Pasteurella pestis*. The bite of an infected flea transfers the bacteria to the animal bitten. Because rats carry fleas, they help spread the disease from city to city and home to home. The rats themselves may become infected with the disease. The bacterial cause of the disease was not discovered until the 1890's – about five hundred years after the great plague of the 1300's. Even when the bacteria was discovered, it was not known for sure how it was spread. It is now known that the disease can be carried directly from person to person as well as by the flea.

In the 1300's, conditions in Europe were bad. Famine and overpopulation had produced poverty and overcrowded towns and cities. Raw sewage polluted the streets, and sanitary facilities were less efficient than those of Caesar's Rome. Cities were rat-infested, and people were ridden with fleas and lice. Conditions were ideal for the spread of a disease such as the plague.

In its journey across Europe, the plague took a great many lives. You can better appreciate the impact of this great crisis if you plot the data from Table 1 on the grid of Figure 1.

Table 1

Approximate Population (in millions)*	Year	Approximate Population (in millions)*	Year
56	1000	61	1450
58	1050	69	1500
61	1100	81	1550
64	1150	101	1600
68	1200	110	1630**
72	1250	100	1660**
79	1300	120	1700
83	1350		
60	1400		

**Estimated data, actual data unavailable*
***Note that these figures are not for 50 year intervals.*

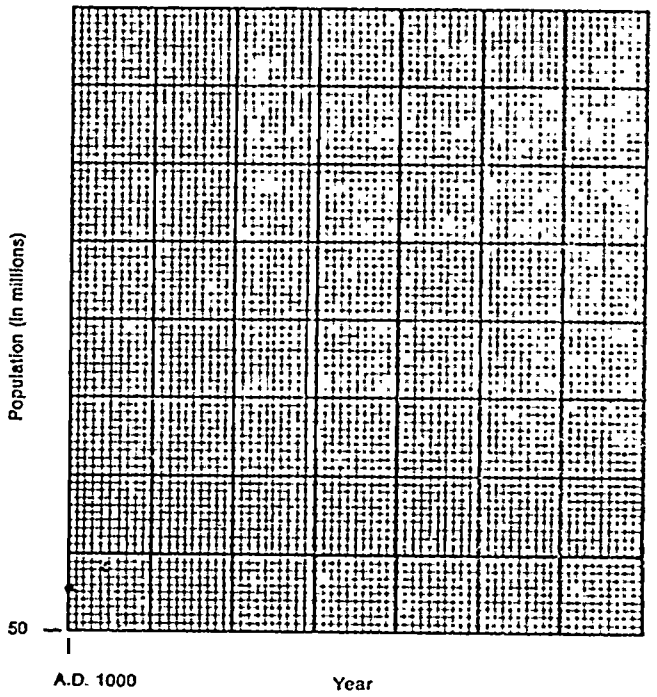
Some graphs don't start at zero. As you label your vertical scale on Figure 1, notice that you can label the bottom line "50" (for a population of 50 million). Every *horizontal* line can then stand for an increase of one million in the population. And your vertical scale can take care of a range from 50 million to 120 million people. Label only the lines that show an increase of 10 million population, and your scale won't become cluttered.

The horizontal scale shouldn't start at zero either. Label the left-hand vertical line "1000," and you should be able to complete the scale easily.

☐1. As you move to the right on the horizontal scale, what increase in years will you let each thin vertical line represent? each heavy vertical line represent?

☐2. Explain why you think it is, or is not, necessary to label on the horizontal scale every year that is listed in Table 1?

Figure 1



☐3. According to your graph, when did deaths from the plague occur at the fastest rate?

☐4. How many years passed before the population of Europe again rose to the pre-plague level?

☐5. What do you think might account for the dip in the graph during the 1600's?

☐6. How would you find out if your answer to question 5 is a good one?

STUDENT COMMENT NO. 13: A Feast for Vultures

Across Africa's broad chest, from Senegal to Ethiopia, the worst drought of the century continues to cut a 4,000 mile swath of devastation. After six years of light rainfall, nearly one-third of the 51 million people who live in this band from the Atlantic to the Red Sea are threatened by starvation. Not even a good rainfall this season can end the tragedy, so wasted is the land and so slight the prospect of a bountiful harvest. Worst hit are Ethiopia and the six nations of the arid Sahel . . .

Sahel's prinicple rivers, the Senegal and the Niger, have fallen to their lowest levels since the start of the century. Lake Chad has evaporated to one third its normal size and has actually separated into four parts. The fishing village of Bol, once a lakeside settlement, today looks out on a vast wasteland of parched scrubgrass stretching 18 miles to the water. The lake's fish catch has been halved, creating a protein deficiency that aggravates an already short supply of grains. In northern Chad, nomads are eating boiled tree bark and roots . . .

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In Ethiopia, famine in Welo and Tigre provinces left nearly 100,000 dead last year; some people were so weakened that when a rainstorm struck Dese, the capital of Welo, they drowned in a couple of inches of water, unable to raise their heads from the gutter. Now the drought is expanding into other areas. In Harar province's Danakil Desert, the nomadic tribesmen are in danger of dying out as a race . . .

The Ethiopian government expects that it will have to provide emergency relief for 4 million of its 26 million people. Even the start of the spring rains may do more harm than good. In parched Harar province, four days of torrential downpours last month swelled the Awash River to 14 feet above its normal level, flooding thousands of huts, killing dozens of peasants, and washing away tons of topsoil that the area needs if it is ever to recover . . .

Emergency relief may buy time for Ethiopia, enabling its new government to make the investments necessary to avoid future famines. The prognosis for the Sahel, however, is much worse. Even though the leaders of the six nations last autumn formed a committee that prepared a $700 million list of 126 development projects including hydroelectric dams, deep wells, and reforestation programs, the Sahel's chances of survival are uncertain. In the past six years the Sahara has crept continually southward, progressing as much as 100 miles in some places. If this is the result of a basic change in the weather patterns, then according to a British meteorologist, "all mankind's efforts to halt the desert encroachment of the Sahel will be futile."

The regions six nations, therefore, may be confronting a bleak Malthusian future in which the most basic needs of their populations will fatally outstrip the productive potential of the land. A U. S. intelligence analyst speculates, "We don't know if the Sahel countries will even be here in ten years."

--Time Magazine, April 8, 1974, pp. 40-41.

STUDENT COMMENT NO. 14: "Acts of God"

Tornado Loss 'Unbelievable'; 329 Dead, Thousands Injured

Associated Press

Rescue workers counted the dead Thursday and tried to help the living rebuild after the nation's worst tornados in 49 years left at least 329 dead and thousands injured or homeless. President Nixon declared five states federal disaster areas.

Tornados Strike Michigan Towns

Maine Town Battling Spring Run-Off Flood

Volcano Refugees Return

Hurricane Carla Kills 157

Severe Earthquake Hits In Southwestern China

Rain-Fed Flooding Kills

Peru Landslide Toll Hits 43

LIMA, Peru (AP) — An engineering team armed with dynamite struggled through rain and mud Sunday to clear giant landslides high in the Andes of central Peru that killed 43 people, wiped out at least three villages and threatened another six with sudden extinction.

Fiji Records Major Quake

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STUDENT COMMENT No. 15: The Changing World Population

World population at the beginning of 1969 numbered 3.5 billion. About one and a half generations ago, in 1930, it was 2 billion. About eleven or twelve generations ago, in 1650 - the onset of the modern era - it was only half billion. In little more than one generation hence, 2000, world population could easily reach 7 billion and possibly exceed this number. In about two human generations from now, 2020, world population could approximate 10 billion; and in about four human generations, 2070, world population could exceed 20 billion.

Estimated world populations are:

Neolithic period (new Stone Age) - 10 million

Christian era - 200-300 million

modern era (1650) - 500 million

1969 - 3.5 billion

A relatively simple analysis of these numbers discloses that an enormous increase in the rate of world population has occurred, especially during the past three centuries. This increase in world population could be attributed to the following: (1) pressure from society (2) political pressure (3) various religious beliefs and (4) ignorance. Society stresses the social significance of having children. The distribution of political power is affected by the proportions of age groups. ethnic groups, or social classes. Any changes affecting these groups, whether from differential fertility rates or migration can affect the balance in a federal system; for example, the changes in ratio between Hindus and Muslims in northeastern India, Catholics and Protestants in Northern Ireland and blacks and whites in American cities have had dramatic political consequences. Many religious groups have definite beliefs about control of the population. Some believe man should control his family size; while others are against major birth control devices. Of course, ignorance in many parts of the world have a great influence on the size of world population. It is clear that greatly accelerated growth occurred first among the nations that first experienced modernization. Explosive population growth did not reach significant proportions among two thirds of mankind in Asia, Latin America, and Africa until after World War II - less than one human generation ago.

The reason for the population explosion can be found in the interaction of the components of population growth - birth (fertility) and deaths (mortality) for the world as a whole, and fertility and mortality and net migration for any subdivision of the world.

The decrease in death rate may, in general, be attributed to a number of causes:

1. Increased productivity ushered in by the agricultural, commercial, and industrial revolutions resulting in higher levels of living — including better nutrition, better living conditions, and better health.
2. The emergence of national governments with the elimination of deadly warfare and the emergence of national markets which permitted a more equitable distribution of the nation's product.
3. Improvements in environmental sanitation and personal hygiene, resulting in uncontaminated food and useable water and a decrease in the probability of infection and contagion.
4. The natural disappearance of some of the agents of disease and death; for example, scarlet fever.
5. The development of modern medicine.

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"World Population: Retrospect and Prospect," Rapid Population Growth, 1971.

STUDENT COMMENT NO. 16:

PEPPER .... *and Salt*

Paper Caper

("Paper Companies Come Out of Their Slump; Rising Demand and Prices Are Forecast."—WSJ headline)

For boosting the paper industry
Thank the ecologists,
Who turn out tons of books and tracts,
The theme of which insists
That we are all extinction-bound
Unless we come in aid of
Our natural assets. That includes
The trees that paper's made of.

—E. V. Girard.

Wall Street Journal, January 3, 1973.

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STUDENT COMMENT NO. 17: Zero Population: Not All Good

As recently as a year ago, there was eerie, 1984-ish talk of "parent licenses," punitive taxes for overproduction of children and even "baby ration cards" for couples. America's -- and the world's -- population was growing so fast, we were told, that we'd soon run out of space and resources to feed, clothe and house us all. ZPG--Zero Population Growth--was the new religion, and it was winning converts by the thousands.

Well, ZPG is here, at least for the United States, and now comes somebody telling us that we don't want it after all.

That somebody is Amitai Etzioni, Professor of Sociology at Columbia University, who says we may have paid so much attention to such things as ecological imbalance and diminishing natural resources that we neglected to notice that ZPG has some negative effects as well.

Writing in the current issue of a new magazine, Evaluation, Dr. Etzioni has no doubt that the United States--as a result of deliberate individual choice, an increase in the number of working wives, rising divorce rates and changing values--has achieved ZPG, with maybe a little to spare.

The Census Bureau says that a birthrate of 2.1 per woman is "replacement level" fertility--ZPG. In the 1950s, the birthrate was 3.7. And thought it had fallen to about 2.4 by a year ago, there was still some fear that our rampant virtility would shortly do us in.

Dr. Etzioni cites March 1973 figures showing a sharp decline over the past couple of years, to the point that we are now down to the less-than-replacement rate of 2.03.

"We have been conditioned by years of intensive campaigns to view population growth as a source of many evils, including crowding, tough competition over ever scarcer resources, war, low standards of living and so on," Etzioni says. "But as with most propagandistic campaigns, the fight for smaller families has looked away from the less attractive facets of the goal." Among the negative consequences of stable or declining population, he lists:

● An aging population, ZPG, almost inevitably, means not just fewer children, but fewer young adults and more old people. Thus there would be increasingly heavy demands for nursing homes, hospitals and the like as well as an increase in health costs because old people are more illness prone and less able to pay for their medical costs.

● INCREASING ethnic and racial strain. Since middle-class and upper-middle-class whites seem more willing to limit the size of their families than the poor, the blacks and certain other ethnic groups, the lower-class and disadvantaged groups will continue to grow more rapidly than the rest of the population.

Etzioni is candid to admit that he doesn't know what might result from ZPG or any other massive attempt to map social policy. His point is that the social planners don't know either.

Today, August 5, 1973

STUDENT COMMENT NO. 18: The Population Bomb[1]

. . . The key to the whole business, in my opinion, is held by the United States. We are the most influential superpower; we are the richest nation in the world. At the same time we are also just one country on an ever-shrinking planet. It is obvious that we cannot exist unaffected by the fate of our fellows on the other end of the good ship Earth. If their end of the ship sinks, we shall at the very least have to put up with the spectacle of their drowning and listen to their screams. . . . .

We, of course, cannot remain affluent and isolated. At the moment the United States uses well over half of all the raw materials consumed each year. Think of it. Less than 1/15th of the population of the world requires more than all the rest to maintain its inflated position. If present trends continue, in 20 years we will be much less than 1/15th of the population, and yet we may use some 80% of the resources consumed. Our affluence depends heavily on many different kinds of imports: ferroalloys (metals used to make various kinds of steel), tin, bauxite (aluminum ore), rubber, and so forth. Will other countries, many of them in the grip of starvation and anarchy, still happily supply these materials to a nation that cannot give them food? Even the technological optimists don't think we can free ourselves of the need for imports in the near future, so we're going to be up against it. But, then, at least our balance of payments should improve! . . . .

Obviously our first step must be to immediately establish and advertise drastic policies designed to bring our own population size under control. We must define a goal of a stable optimum population size for the United States and display our determination to move rapidly toward that goal. . . . .

[1]Dr. Paul R. Ehrlich specializes in population biology. He is a Professor of biology and Director of Graduate Study for the Department of Biological Sciences, Stanford University. Dr. Ehrlich has written many papers and several books concerning the dangers of over-population and related matters.

The idea of an ever-expanding economy fueled by population growth seems tightly entrenched in the minds of businessmen, if not in the minds of economists. Each new baby is viewed as a consumer to stimulate an ever-growing economy. Each baby is, of course, potentially one of the unemployed, but a consumer nonetheless. The Rienows[2] estimate that each American baby will consume in a 70-year life span, directly or indirectly: 26 million gallons of water, 21 thousand gallons of gasoline, 10 thousand pounds of meat, 28 thousand pounds of milk and cream, $5,000 to $8,000 in school building materials, $6,300 worth of clothing, and $7,000 worth of furniture. It's not a baby, it's Superconsumer!

Our entire economy is geared to growing population and monumental waste. Buy land and hold it: the price is sure to go up. Why? Exploding population on a finite planet. Buy natural resources stocks; their price is sure to go up. Why? Exploding population and finite resources. Buy automotive or airline stocks; their price is sure to go up. Why? More people to move around. Buy baby food stocks; their price is sure to go up. Why? You guess. And so it goes. Up goes the population and up goes that magical figure, the Gross National Product (GNP). And, as anyone who takes a close look at the glut, waste, pollution, and ugliness of America today can testify, it is well-name -- as gross a product as one could wish for. We have assumed the role of the robber barons of all time. We have decided that we are the chosen people to steal all we can get of our planet's gradually stored and limited resources. To hell with future generations, and to hell with our fellow human beings today! We'll fly high now -- hopefully they'll pay later. . . . .

Ways must be found to promote the idea that problems associated with population growth will more than cancel the "advantages" of financial prosperity. Perhaps the best way to do this would be to encourage Americans to ask exactly what our financial prosperity is for. What will be done with leisure time and money when all vacation spots are crowded beyond belief? Is it worth living in the Los Angeles smog for

[2]Moment in the Sun, Dial Press, Inc., N.Y., P. 3.

50 weeks in order to spend two weeks in Yosemite Valley -- when the Valley in the summer may be even more crowded than L. A. and twice as smoggy? What good is having the money for a fishing trip when fish are dead or poisonous because of pesticide pollution? Why own a fancy car in which to get asphyxiated in monster traffic jams? Do we want more and more of the same until we have destroyed ourselves? Sizable segments of our population, especially the young, are already answering that question: "Hell, no!" Their response should be considered carefully by population-promoting tycoons. . . . .

Legal steps must be taken, and taken fast, to see to it that polluters pay through the nose for their destructive acts. The old idea that industry could create the mess and then the taxpayers must clean it up has to go. The garbage produced by an industry is the responsibility of that industry. The government should not use other people's money to clean it up. Keep the government out of business. Let it play its proper role in a capitalistic society seeing to it that all segments of private enterprise do business honestly, seeing to it that the interests of the fishing industry are not subordinated to those of the petrochemical industry, seeing to it that your right to swim in a public lake is not subordinated to the desire of a steel company to make an inflated profit. . . . .

Dr. Paul R. Ehrlich, The Population Bomb (New York: Ballantine Books, Inc., 1968).

STUDENT COMMENT NO. 19: America's Population Crisis

AMERICA is in the midst of a population crisis that threatens our traditional way of life. It is a crisis that becomes more severe with every day of the 1960's. It promises to become a national catastrophe and is already costing us heavily in money, terrible social problems and lost liberty.

Until now, most Americans have assumed that the worst of the world population explosion was bypassing us. Of course, we have noted that our schools have been swamped and that our highways are jammed, but we regard these as relatively minor penalties. We look for the "real" problems of the population crisis in such far-off and teeming places as India and China. America, we observe, has food to burn.

Businessmen cheer because population growth obviously contributes to our economic boom—providing more and more people to buy goods and services. While increasing our population some 70 per cent between 1950 and 1980, we happily contemplate the prospect of doubling our national output of goods and services. All of us, then, should live better. But will that be true if our population continues to increase at the present rate of 1.8 per cent a year?

Between 1940 and 1960, our population gain of 48 million was almost equal to the total population of the United Kingdom. By 1970, at our present rate of increase, we would have a population of 215 million. By 1980, we would have 260 million citizens, an increase over today's 180 million that is about equal to the population of the United Kingdom *and* Canada, Sweden, Norway and Denmark. By the year 2,000, our population would be around 385 million—a gain of another 125 million—enough to set up a new country that, in terms of today's populations, would be the fifth largest nation.

If this grim trend continues in the first half of the next century, we will *add* about 620 million to our population—about as many as live in all of China today—and have a population of one billion persons. This isn't science fiction. Some persons now living will be around in 2050, when our population may reach the billion mark.

If you project the figures further, you find that the same growth rate, untamed, will produce one human being for every square foot in the land within 800 years. But there is no need to look that far ahead. Our present population problems are bad enough.

Admittedly, America faces no immediate food shortages, since the cropland actually in use averages more than two acres for every person living. But a population of one billion would leave us less than four tenths of an acre per person, close to that of the poorest lands.

The crisis in raw materials is more urgent. In 1900, we produced 15 per cent more raw materials than we used. By mid-century, we were *consuming* 10 per cent more raw materials than we produced, and a Presidential commission noted that 33 vital minerals were already on a critical-shortage list. We may not be able to depend on other countries very long for our present raw-material needs, let alone the increased needs of an expanding population. Foreign nations increasingly have their own shortages because of population gains.

Crisis in our cities

The population crisis is felt right now in our metropolitan centers. In 1950, less than 85 million persons lived in 168 metropolitan areas. In 1960, about 113 million—63 per cent of the total—lived in 212 such areas. Population concentrated in metropolitan areas increased over 32 per cent between 1950 and 1960, somewhat less than twice the national growth.

Most of this new growth has been in the new suburbs that ring our cities. The growth is often unplanned and uncontrolled. Some new suburbs are slums virtually before the concrete is dry. These are communities developed without regard for water supply, drainage, sanitation and other urban services. Sometimes this lack is due to a deliberate effort to evade zoning and code requirements.

It took 16,000 governmental units, each with the power to tax and spend, to see to the diverse needs of the 168 metropolitan areas that existed in 1950. Today, there are still about 100 government units, on the average, in each metropolitan area. New York and Chicago have a thousand such units. The duties of this hodgepodge of governmental units overlap, taxes are high, and efficiency and effectiveness are doubtful. Police have greater difficulty crossing suburban boundaries than do criminals.

With the vastness and complexity of local government, many vital needs go unfilled, and new governmental units are constantly being created. Sanitary districts are formed, mosquito-abatement boards are set up, and water commissions go into action, creating even more confusion. Some fear the trend toward supergovernment. The consolidation of Miami and Dade County in 1957 was an example.

The failure of the cities to have many of their needs met has brought open warfare between "home-rule" forces of the big cities and the rural-dominated state legislatures. A showdown is in the offing as the exodus from farms continues and rural areas lose population. Angered city people more and more are bypassing state governments to get what they want. The urgent needs for urban renewal, housing, street and highway programs and health services are being met increasingly by the Federal Government as the state governments shuffle helplessly or aimlessly along. Many will mourn the passing of the powers and functions of state government and its safeguards. "Big" government must, unfortunately, bring new invasions of individual freedom.

The dollar cost of the population boom is high. Part of the cost is the $33 billion we must raise this decade to pay for urban services, such as schools, fire engines and sewers that our cities will need for their added population. Experts estimate that we must invest about $1,100 per capita to assure urban services.

Other costs will be hidden, but just as real. Juvenile delinquency today costs us a vast fortune in stolen and damaged property, lost incomes and maintenance of courts and social agencies. Even if the rate of delinquency remains constant, the problem will increase by 44 per cent during this decade, just because of the increased size of the age group between 15 and 19, where delinquency is concentrated.

There is no estimating the countless billions of dollars needed to build public transportation systems throughout the country. Our city streets are hopelessly choked with traffic. Lawmakers will ultimately recognize that a single lane of rapid-transit trains can do the work of 32,000 private cars and more than 20 lanes of traffic. It takes more than 1,100 cars and four traffic lanes to do the work of one lane of 50-seat buses or trolley cars.

Cities such as New York soon must drastically limit parking and driving. In many areas, suburbanites will be allowed to drive only to the edge of the city, where public transportation will carry them to the center. Public transportation will be regarded as a necessity, like piped water and sewer lines. And it will cost a fortune.

Population growth has increased migration within our country. Negroes and whites from the rural South have flocked to the cities in large numbers. Two thirds of our 20 million nonwhites now live in urban areas. Better public health and medicine available to Negroes in urban areas have not only greatly decreased the Negro death rate, but simultaneously have greatly increased the Negro birth rate.

Today, the Negro population is increasing at a rate 60 per cent *ahead* of the white population. This contributes to the frictions between whites and Negroes in our large cities. And the poverty of city Negroes contributes to keeping them a depressed ghetto group living in the midst of crime, poverty, broken homes and social disorganization.

The quality of education in the 1960's is bound to be reduced by the population boom, just as it was in the '50's. The postwar baby boom has radically increased our school-age population. During the 1950's, postwar babies flooded the educational facilities in general.

Elementary schools in the 1950's were forced to make room for about 50 per cent more students. It was impossible to maintain the quality of education in the face of such a deluge. During the 1960's, these postwar babies will tax our high schools with a 48 per cent enrollment increase. Our colleges must accommodate 92 per cent more enrollments.

Another sinister sign is that, for the first time in our history, the number of mouths we must feed is growing more rapidly than hands that can work. Those below working age and those above the working years are increasing more rapidly than are persons of productive age (20 to 64 years). This will make it increasingly difficult to achieve any gains in living standards for ourselves and our children.

Young people looking for a vacation job last summer had a hard time finding work. One by-product of the changing age structure is the accelerating rate of new workers entering the labor force. In 1960, the first postwar babies reached working age. Some 200,000 young workers a year were added to the job force in the last half of the 1950's. In the '60's, this number is tripling, and there is serious doubt whether our economy can expand fast enough to absorb such numbers in the face of new unemployment caused by automation.

We face still other consequences in the rapid population growth that is crowding us together more and more. Whole sections of our aging cities are urgently in need of rebuilding. But as we tackle these slums, new ones are growing at an ever faster rate. We must pay many other costs for this overcrowding.

And what can we do about our already overburdened parks and recreational areas? How can we save our polluted rivers and streams for future generations? Where are we to find more water for homes and industry every decade? Can we make progress against air pollution in the face of more and more people and industry doing the polluting?

Many persons regard the raising of such questions as "alarmist." Others recognize the facts about our population explosion, but contend that we must outbreed China and the Soviet Union.

Such proposals are exposed as ridiculous when one accepts the United Nations' "medium" estimates that China and the USSR will have a population of more than two billion by the year 2000. Our present birth rate would give us about the same population as the USSR, 400 million. All of Europe combined (including some of the smaller Communist nations) would, by the same projection, have less than 600 million persons. It is obvious that we cannot hope to win a breeding contest.

Certainly, in this age of the H-bomb, there is no relationship between the population of a country and its military power. It would be a doctrine of despair to argue that we need more people in order to have some survivors after the next war! A competition in breeding between the free world and the Communist bloc would only help reduce us to the Communists' miserably low level of living, and it would probably invite rather than retard the expansion of communism.

The answer to our problems lies in the control of our population growth of 1.8 per cent a year. That growth results from a birth rate of 25 (per thousand population per year) and a death rate of nine (per thousand population per year), together with a few immigrants (less than 300,000 a year in the 1950's).

Since we would not want to increase our death rate, a need for reduction of the birth rate becomes evident. The United States, unlike the underdeveloped areas of the world, is in a relatively favorable position for controlling its population growth. We have already done a lot about controlling our fertility. The postwar birth rate of the U.S., high as it is, is only about half of what it was in 1800. Decreases in deaths have been so spectacular, however, that halving the birth rate is not enough to prevent continued explosive growth.

Achieving an optimum birth rate

How much of a cut in the birth rate is indicated? It would take a further decrease in the birth rate of about 40 per cent to produce a stationary population. A one-third decrease in the birth rate would produce a growth of about one half per cent a year. At that rate, the population of the U.S. would double in about 140 years, instead of 40 years; this would greatly reduce the terrible consequences of our population explosion. To achieve such a result, the U.S. need only do more of what it is already doing to control its fertility. By contrast, the underdeveloped areas, faced with even more severe consequences of explosive population increase, have yet to begin the process of effective fertility control.

Objections to some of the methods of birth control available should not prove to be a serious obstacle. With the wide variety of methods of birth control available to the American people, each of our diverse groups can find one that is morally acceptable.

Much more important than the debate over suitable methods of controlling fertility is recognition of the need for responsible parenthood in the interest of the individual, the family, the nation and the world. Nothing else can overcome the runaway problems of America's population crisis.

LOOK MAGAZINE

BY PHILIP M. HAUSER

as told to JACK STAIR
LOOK SENIOR EDITOR

STUDENT COMMENT NO. 20: The Nonsense Explosion[1]

. . . . Crowded, crowded, crowded, we are told. Slums are crowded, suburbs are crowded, megalopolis is crowded and more and more and more people are eating up, burning up and using up the beauty and wealth of America -- turning the land into a polluted, depleted sprawl of scummy water and flickering neon, an ecological catastrophe stretching from the Everglades to the Pacific Northwest. Crisis. Crisis. Crisis.

That so very much of this is preposterous, as we shall see, should come as no real surprise to those who follow the fads of crisis in America. . . . .

--The critical facts are that America is not by any standard a crowded country and that the American birth rate has recently been at an all-time low.

--The critical premise is that population growth in America is harmful.

In not stating the facts and in not at least challenging the premises, politicians and planners alike seem to be leaving themselves open to both bad planning and bad politics. This happens by concentrating on what the problem is not, rather than on what the problem is. Let's, then first look at the facts. The current population of the United States is 205 million. That population is distributed over 3,615,123 square miles of land, for a density of about 55 persons per square mile. In terms of density, this makes the United States one of the most sparsely populated nations in the world. . . . .

But while it is of interest to know that America has some land that is uninhabitable, what is of far more importance is that we have in the United States vast unused areas of eminently habitable land, land that in fact was inhabited until very recently. . . . .

[1]Ben Wattenberg served on President Johnson's White House staff He co-authored a book on demography titled This U.S.A., published by Doubleday in 1965.

We can now turn to the premise set forth by the Explosionists i.e., more Americans are bad.

Are they? My own judgement is -- not necessarily. . . . .

The Explosionists say people, and the industry needed to support people, cause pollution. Ergo: fewer people -- less pollution.

On the surface, a reasonable enough statement; certainly population is one of the variables in the pollution problem. Yet, there is something else to be said. People not only cause pollution, but once you have a substantial number of people, it is only people that can solve pollution. Further, the case can be made that, more people can more easily and more quickly solve pollution problems than can fewer people. For example: let us assume that $60 billion per year are necessary for national defense. The cost of defense will not necessarily be higher for a nation of three hundred million than for a nation of two hundred million. Yet the tax revenues to the government would be immensely higher, freeing vast sums of tax money to be used for the very expensive programs that are necessary for air, water, and pollution control. Spreading constant defense costs over a large population base provides proportionately greater amounts for non-defense spending. The same sort of equation can be used for the huge, one-time capital costs of research that must go into any effective, long-range anti-pollution program. The costs are roughly the same for 200 or 300 million people -- but easier to pay by 300 million. . . . .

Next, the Explosionists view more people as a crisis because of all the demands they will make upon the society. So many new schools, so many more hospitals, more libraries -- services and facilities which we are having difficulty providing right now. Similarly with "new towns." If we are to avoid vast and sprawling megalopolitan swaths, we are told, we must build 100 brand-new towns in 30 years. Unfortunately, we've only been able to construct a few in the last couple of decades -- so, alas, what possible chance do we have to make the grade in the years to come?

What this argument ignores, of course, is that it is not governments who really create schools, hospitals, libraries and even new towns. It is people who create and build. People pay taxes; the taxes build and staff the schools; the more people, the more need for schools, and the more taxes. In an uncanny way it usually works out that every child in America has his own set of parents, and a school to attend. In a nation of a hundred million there were roughly enough schools for the children then present, at two hundred million the same was true and, no doubt, it will hold true at three hundred million. Nor will quality suffer because of numbers; quality suffers if taxpayers aren't willing to pay for quality and it is not harder for 300 million Americans to pay for quality schools for their children than it is for 230 million to buy quality schooling for their offspring. . . . .

There is next the "resources" argument. It comes in two parts. Part one: many of our resources are finite (oil, coal, etc.); more people obviously use more resources; the fewer the people, the less the drain on the resources. Part two: we Americans are rich people; rich people use more resources; therefore, we must cut back population particularly fast, and particularly our rich population.

The resources problem is difficult to assess. A demographer now in his sixties seemed to put it in perspective. "Resources are a serious problem," he said, "We've been running out of oil ever since I was a boy."

The fact is, of course, sooner or later we will run out of oil; perhaps in thirty years or fifty years, or a hundred years or two hundred years. So too will we run out of all nonrenewable resources -- by definition. We will run out of oil even if population growth stops today and we will run out of oil, somewhat sooner, if population growth continues. Whether oil reserves are depleted in 2020 or 2040 or 2140 does not seem to be of critical importance; in any event a substitute fuel must be found -- probably nuclear. If no adequate substitute is developed, then we (all us earthmen) will suffer somewhat regardless of numbers.

Part two, that rich people are the real menace both resource-wise and pollution-wise, has recently been particularly stressed by Dr. Jean Mayer who advises the President hunger-wise but would not seem to be fully up to date demography-wise.

For the simple fact is that wealthier people generally have far fewer children than poorer people. With current mortality rates, population stability is maintained if the typical woman has on the average 2.13 children. In a 1964 Census Bureau survey among women who had completed their child-bearing years, it was shown that families with incomes of $10,000 and over had 2.21 children, just a trifle over replacement. This compared with 3.53 children for the poorest women. Since 1964, fertility rates have gone down among young women, and it is possible that when these lower rates are ultimately reflected as "completed fertility" we may see that affluent American women of the future just barely replace their own number, if that.

In short, current population patterns show that affluent people do not cause rapid population growth. And if the entire population were entirely affluent, we certainly would not be talking about a population explosion. Further, if the entire population were affluent and committed to combatting pollution, we wouldn't be talking about a pollution explosion either.

What then is Dr. Mayer's prescription? Is he against affluent people having babies but not poor people, even though the affluent have relatively few anyway? Of perhaps it is that he is just against the idea of letting any more poor people become affluent people, because they too will then consume too many resources and cause more pollution?

There are two important points that run through most of the above. First is that the simple numbers of people are not in themselves of great importance in the United States. There is no "Optimum" population as such for the U.S., not within population ranges now forecast in any event. Whether we have 250

million people or 350 million people is less important than what the people -- however many of them there are -- decide to do about their problems. Second the population problem, at least in the United States, is an extremely long-term proposition, and in a country of this size and wealth, there is more flexibility in solving the potential demographic problems than might be assumed from the current rhetoric-of-crisis. . . .

Certainly too, population growth must sooner or later level off. While America could support twice its current population and probably four times its current population -- growth can obviously not go on forever and it is wise to understand this fact now rather than a hundred years from now. . . . .

But what is wrong, and dangerous, and foolhardy is to make population a crisis. Doing so will simply allow too many politicians to take their eyes off the ball. When Explosionists say, as they do, that crime, riots and urban problems are caused by "the population explosion," it is just too easy for politicians to agree and say sure, let's stop having so many babies, instead of saying let's get to work on the real urban problems of this nation. (As a matter of general interest it should be noted that the riot areas, the high-crime areas, the areas of the most acute urban problems are areas that are typically losing population. For example, special censuses in Hough and Watts showed population loss. Given that kind of data it is hard to accept the Explosionist notion that crowding causes crime.) . . . .

When the Explosionists say, as they do, that it's because we have so many people that Lake Erie is polluted then once again we are invited to take our eye off the tens-of-billions-of-dollars ball of environmental safety and we are simultaneously invited to piddle around with 25-million dollar programs for birth control, which are nice, but don't solve anything to do with Lake Erie.

Finally, we must take note of the new thrust by the Explosionists: population control. Note the phrase carefully. This is specifically not "family planning," where the family concerned does the planning. This is control of population by the government and this is what the apocalyptics are demanding, because,

they say, family planning by itself will not reduce us to a zero growth rate. The more popular "soft" position of government control involves what is called "disincentives," that is, a few minor measures like changing the taxation system, the school system and the moral code to see if that won't work before going onto outright baby licensing. . . .

What it all adds up to is this: why have a long-range manageable population problem that can be coped with gradually over generations when, with a little extra souped-up scare rhetoric, we can drum up a full-fledged crisis? We certainly need one; it's been months since we've had a crisis. After all, Vietnam, we were told, was "the greatest crisis in a hundred years." Piker. Here's a crisis that's a beauty: the greatest crisis in two billion years: we're about to breed ourselves right into oblivion. . . .

Ben Wattenberg, "The Nonsense Explosion," The New Republic, April 4 and 11, 1970, pp. 18-23.

STUDENT COMMENT NO. 21: It's Time to Defuse Population "Explosionists"

Americans have been overwhelmed by an avalanche of scare rhetoric about the "population explosion." We have been assured that it is not only the greatest problem facing the world, but also our greatest problem.

The rhetoric goes something like this: If growth rates continue unchecked, in 600 years there will be one person for every square yard of the earth's surface. In 900 years a building 2,000 stories high covering the whole world will be needed to house the immense throng. The exploding U.S. population will keep pace: 375,000,000 Americans by A.D. 2000., 939,000,000 by 2050, and 2,350,000,000 by 2100.

Birth Rate Declines

Explosionists advocate unprecedented measures to stem the force of this impending tidal wave of humanity. Suggested solutions for the United States range from tax disincentives to nearly unlimited abortion and eventual government control.

All of this is in the face of a steadily declining birth rate in the United States. The birth rate and the number of babies born each year from 1957 to the present are:

Year	Births	Rate
1957	4,308,000	25.3
1958	4,255,000	24.5
1959	4,295,000	24.3
1960	4,257,850	23.7
1961	4,268,326	23.3
1962	4,167,362	22.4
1963	4,098,020	21.7
1964	4,027,490	21.0
1965	3,760,358	19.4
1966	3,606,274	18.4
1967	3,520,999	17.8
1968	3,470.000	17.4

The birth rate has declined every year from a high of 25.3 per 1,000 in 1957 to a low of 17.4 in 1968. The latter figure is the lowest in U.S. history.

The death rate, at 9.6, has remained almost unchanged in the last 20 years. As our population grows older (which is beginning to occur in consequence of the smaller number of babies born each year) the death rate must eventually rise to 15 in accordance with our life expectancy of 70 years.

(If, in the face of the declining birth rate, the death rate remained at 9.6 permanently, everyone could expect to live to be 104 years old.)

An Overcapacity

A total of 800,000 fewer babies were born in 1968 than in 1961. The consequences of this have not yet been fully appreciated, but these figures mean that in 1976 there will be 800,000 fewer third-graders in the nation's classrooms than there are today. This is not a hazy prognostication, because these children have already been born. There will be an *overcapacity* in teachers, schools, and educational facilities.

In view of these declining numbers and the recent record-low birth rates, it is probable that the U.S. population is already moving toward stabilization. It has become apparent that the Census Bureau's 1967 population estimates for the year 2000 are already outdated and must be revised sharply downward.

These estimates varied from a high of 393,000,000, to an intermediate range between 336,000,000 and 308,000,000, to a low of 283,000,000. The high and the intermediate estimates now seem to be completely out of the question; even the low estimate may be too high. Some demographers now think that the U.S. population will stabilize around the year 2000 at 245,000,000 to 265,000,000.

Extending Too Far

The impact made by the explosionists results partly from their extending trends far into the future. Such lengthy extensions are invalid, for they assume that all population factors will remain constant. Since population factors have a way of not remaining constant, the longer a "trend" is extended, the greater is the likelihood of error.

It is possible, moreover, even with the use of reasonably short extensions, to achieve forecasts that contradict those of the explosionists. One can note, for example, the "trend" in the U.S. birth rate from 25.3 in 1957 to 17.4 in 1968. If this "trend" is extended only 22 years into the future, the birth rate will be down to *zero*.

Similarly, the birth rate declined steadily from 30.1 in 1910 to 18.4 in 1936. If in 1936 this "trend" had been extended only 39 years into the future, births in the United States would have ceased altogether by 1975. This is not only invalid, but ridiculous. Such procedure is, however, not nearly as ridiculous as extrapolations that are mechanically extended for 600 or 900 years.

The chief danger, however, in the scare rhetoric of alarmists is that they tend to reduce many of our major problems to numbers of people. They thus divert attention away from the actual *causes* of the problems. To the extent that the distortions and half-truths find credence, they will retard much-needed solutions.

Crimes and Crowds

The ever-increasing rates of violent crime are attributed to population growth and density. If crowded conditions cause crime, the most crowded areas of the world might legitimately be expected to have the highest crime rates.

Holland, for example, where people are crowded together at a density of almost 1,000 per square mile (compared with 57 per square mile in the United States), should be a very dangerous place indeed. The Dutch, however, who have one of the lower crime rates in the Western world, seem to be unaware of their predicament. Perhaps they have not yet read such books as Paul Ehrlich's *Population Bomb*.

To take another example, Great Britain has 50,000,000 people crowded into an area smaller than California. On the basis of the explosionists' rhetoric it is hard to understand why there are fewer murders in the entire British Isles every year than there are in Chicago or Cleveland, or greater Kansas City. These examples suggest that population density, *in itself*, does not produce crime.

Hindering Reforms

There is danger, however, that irresponsible scare tactics may divert public attention to mere numbers of people. Progress in eliminating slums may be retarded, increased educational and vocational assistance may be delayed, and much-needed reforms in prisons and courts may not be undertaken.

Another favorite theme of the explosionists is environmental pollution. This is, of course, a problem of paramount importance. It cannot, however, be reduced to mere numbers of people. Although more people produce more pollution, they also produce the wealth and the technology to combat it. The crucial factor is determination. Alarmists, by directing attention solely to numbers of people, tend to obscure the fact, admittedly unpleasant, that combating pollution requires large sums of money.

Oversimplification is heard even from government officials. Robert H. Finch, former Secretary of Health, Education, and Welfare, when asked what people could do on a voluntary basis to improve the environment, said: "I would begin by recommending that they start by having only two children."

This is not the heart of the problem. If population growth in the United States ceases today, rivers will remain ecological slums, and air over some cities will remain unbreathable until massive and costly efforts are undertaken to remedy these deplorable conditions. To the extent that environmental problems are obscured by simplistic rhetoric, they will continue to go unresolved.

Congestion in Cities

Finally, the explosionists delight in deploring the ever-increasing crowds in our cities and in our national parks. They ignore the fact that a large part of the urban congestion is a result of the continuing flight from the farm to the city. Fewer farmers are producing more food on less total acreage. As a result of the continuing exodus from the country, one-third of the counties in the nation are losing population; more and more of the populace is being concentrated in metropolitan areas.

Forty-four Kansas and 49 Missouri counties lost population between 1960 and 1966. The latter state, with 69,000 square miles of territory, has three-fifths of its people concentrated in two urban areas. Similar concentrations of people are occurring throughout the United States.

It is apparent that more cities are needed, not merely additional growth in a few metropolitan areas. Most of all planning is needed, so that the cities, new and old, will not be hampered by unrealistic political boundaries, segregated housing, and antiquated transportation systems.

Visitors to National Parks

National parks, as noted by population alarmists, are much more crowded than they were just a few years ago. Attendance has in fact increased by 450 per cent in fewer than 20 years while the population increased by 30 per cent. These figures might suggest all of the following: (a) we are indeed becoming an affluent society, (b) camping is becoming more and more popular, (c) we need more national parks.

Some developing countries have severe population problems. The United States does not. The serious difficulties facing our nation can only get worse if they are simply reduced to numbers of people. Crime, environmental pollution, and urban congestion cannot be eliminated by such simplistic thinking.

It is time to deflate the "population bomb" rhetoric so that we can have a clear view of the real problems.

By Thomas C. Jermann

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STUDENT COMMENT NO. 22: Population Myths

During an era when per capita resources are more abundant than ever before in history and increasing at an unprecedented rate, the popular and scientific news media are filled with statements like the following:

"Too many people, with too little food, on a dying planet."

"Growth is nothing but exploitation; industrial capitalism would be unviable if it had to nourish itself on real growth instead of robbing the earth."

"The sea is dying, time has run out, no world for our grandchildren is remotely possible."

"The earth will be uninhabitable within the next 130 years if depletion of natural resources continues at the present rate."

"The future which we now hold out to the present college generation is one in which their children will at best lead miserable lives and die young."

"To some overcrowded populations, the bomb may one day no longer seem a threat but a release."

These lines, which should frighten even the strongest readers, were written by some leading scholars and intellectuals. As a result they are used as major themes by thousands of teachers across the nation. They have inspired intelligent politicians to propose legislation for family control and have contributed greatly to the lack of confidence that young people everywhere so overtly express for our present social economic and political systems. They have further resulted in the proliferation of a literature that fills our newsstands with ever greater prophecies of doom and have aroused even the most staunch among those confident members of middle America to doubt the efficacy of our national democracy and begin to question the virtue of the contemporary American way of life which they participated in molding and shaping. This is at best a bleak and morbid picture of our so-called "great society" and one that projects little

hope for the future of our children.

Incredible Distortions of Reality

The people who authored these particular statements, as well as the hundreds of others who fill the daily literature with similar grim predictions, are generally well-meaning, thoughtful people. One must respect their dedication to one of the most serious problems of our time. But such statements and opinions are for the most part incredible distortions of the reality of the times in which we live.

Unfortunately, we have had such a massive overdose of "the world is going to hell" propaganda that it is almost impossible to convince anyone that it is not. One only needs to move two or three degrees from the negative pole (let along 180 degrees) and he finds concentrated and radicalized opposition. Calm and rational discussion of the validity of some of the central population explosion concepts is almost impossible. The easy receptivity with which Americans -- especially educators, and religious and community leaders -- have so readily accepted the many doom-sayings offered up during recent years is both impressive and alarming.

There are many cause of the negativism that pervades American society today. However, none has been so consistent and significant as the fear of over-population so strongly expressed in the popular media these last two decades. Indeed it is possible that the extremist views now developing in regard to ecology, free enterprise and the establishment (whatever that is) have grown from and been prejudiced by the over-population fear syndrome.

Myths of the Population Fear Syndrome

- that the world has reached or passed the total number of people it can support at a high living standard

- that the resource base of the world is diminishing and will continue to diminish if the population continues to increase

- that the present world population growth trend of increasing increases will continue indefinitely

- that the places in the world with the most severe population problems are the places with the most dense populations.

Arguments can be given briefly to refute the last two myths. There is clear evidence that a "demographic transition" is occurring throughout most of the world which will in several decades lower growth rates to an average of around 1 per cent -- a situation nearly reached in the western world. Also, population density, especially regarding the ratio of population to arable land, is greater in Benelux, United Kingdom, Japan, West Germany than in India, China, Africa and Latin America.

Now to look more extensively at the first two myths. In nearly all discussions and writing about the population explosion, the heart of the matter almost always revolves around the availability of food -- the question of whether or not we can find more and more food for more and more people. It is generally concluded -- and usually with dogmatic certainty -- that we cannot.

There is no question but that many of the people in the world do not have enough food and unfortunately large numbers of people die of starvation every day. But this tragedy primarily results from undeveloped resources or food distribution problems and not a reflection of an infertile earth.

No doubt the earth could feed two, five, ten times its present population with few advances in agricultural know-how. The United States could, for example, grow to seven times its present population without exceeding the farmland population density of West Germany; to thirty times its present population -- or twice the current population of the world -- without exceeding the press of population upon agricultural land in 1970 Japan.

And with great advances in agricultural technology -- who knows? It is probably that agriculture could continue to support population growth until man became so numerous and heavy some thousands of years hence that "his combined weight could cause an imbalance in the earth's rotation and/or revolution and cause the planet to fly crazily off into outer space."

Here are just a few examples of how we might expand future food supplies:

(1) Apply western agricultural technology to the rest of the world; spread knowledge about new chemical fertilizers, play hybrids, methods of disease control. Charles Kellog, one of the world's greatest soil scientests, estimates that world wide utilization of modern soil-improvement processes could increase agricultural yields by two to five times within a relatively short period. A recent study of Middle East productivity conducted by Resources for the Future also concluded that the introduction of modern farming practices in the Middle East could result in increased agricultural outputs ranging from 50 per cent in Israel to as much as 1000 per cent in Iraq.

(2) Irrigate the 35 per cent or so of the earth's surface now dry and relatively unused. One method, irrigation by desalinized salt water, is already in use. Three other alternatives are being studied: salt water irrigation, use of atomic energy, satellite sensing techniques.

(3) Drain millions of acres of land for adaptation to agriculture. Some of the best farm land in use today -- Great Lakes Region, Southeast United States, the Low Countries, the Ganges Delta -- is drained swamp land. Millions of acres of undrained swamp lands offer potentially rich agricultural land.

(4) Cultivate food from the sea. Four-fifths of the plants and animals known to man live in the sea. The ocean environment is so desirable for life (because of its less variable "weather") that growth rates are rapid and crops mature in a much shorter time than in the atmosphere.

(5) Use yeast and similar sources of protein that will reproduce themselves naturally, almost as fast as they are consumed.

(6) Cultivate lichens and other plants growing in tundra areas. A prominent geographer, J. Russell Smith, once estimated that there is enough food in tundra regions to feed the world.

(7) Harvest various tree leaves which fall uselessly to the ground each year but which, with some dietary adaptation, could provide googolplexes of annually replenishable calories.

Malthus said that as the fertility of man increases, the fertility of the soil decreases. That is pure nonsense. Man not only has the ingenuity to increase the fertility of the soil as he has done in so many of the prosperous agricultural areas in the U.S. (i.e. the Southeast where he has developed a healthy agricultural economy on naturally inferior soils) -- but if necessary, he has the ability to make his own "soil" as he is now doing in some places -- using sawdust and other similar materials. And it may be that in the future he will use solid less and less and turn to other substances, e.g., water in which to grow his food.

Resources Don't Exist, They Become

The second myth says that the resource base of the world is diminishing and will continue to diminish if population continues to increase. Malthus was one of the first to state the alleged problem when he said essentially that man expands geometrically -- something like rabbits, 2-4-8-16 -- and that resources grow arithmetically -- 1-2-3-4. A more recent expert emphasized the same problem when he stated: "The earth will be uninhabitable within the next 130 years if depletion of natural resources continues at the present rate." Although he and Malthus gave their warning more than a 100 years apart both were saying basically the same thing: as population expands, resources become more scarce.

The hypothesis is wrong. Resources don't exist -- they become. They are creation/inventions of man's mind. They therefore reproduce at a rate related to the reproduction rate of people. And in fact -- something that people will find nearly impossible to believe after having been exposed to generations of distortions -- as long as the educational level of mankind continues to rise -- which most experts will agree

is occurring (no matter how slowly) -- the mind will become increasingly capable of inventing resources. And the more educated the mind, the more the resource creation of a single mind exceeds the needs of that person -- therefore providing a surplus for others. This means the population explosion is resulting in a lessening of pressure upon resources rather than an increasing of pressure upon resources. (Which in fact is clearly reflected in the slowly rising standard of living of the world's people -- evidence that is either unknown to or ignored by many population experts.)

There is almost no important resource in the world today that just suddenly washed up on the beach or dropped out of the sky. People learned how to use something to the advantage of society and then -- and only then -- did it "become" a resource.

As a result of this dynamic process by which man develops resources (rather than stumbling over them in the dark), the resource base of the world has expanded more rapidly than the need generated by the population explosion. Our total resource supply is not being steadily decreased by over-consumption as has been broadcast everywhere but is rather growing at an unprecedented rate. Per-capita food consumption is increasing, life-spans are lengthening, literacy rates are rising, leisure time is increasing and the creative frontier is expanding at an expanding rate.

We are not living in a time of increasing scarcity but of increasing abundance. And it is time we championed in the media, in the schools, in the churches and in the streets the real nature of our civilization and of the opportunity it offers for ourselves, our children and the world.

Schmieder, Allen, Some Myths of the Population Explosion. Reprinted with permission from the Dec. 1971 issue of engage, copyright 1971 by the Board of Christian Social Concerns of The United Methodist Church.

STUDENT COMMENT NO. 23: Dublin Cheers Population Rise

If the latest Irish census figures for the period 1966-'71 can be taken as an indication of the progress of the country, it would appear that Ireland is faring better than it has for a very long time.

For the recently published returns indicate that the population of the Republic now stands at 2.971 million, an increase of 87,228 in five years and the second consecutive increase in population to be recorded at these five-yearly counts since the disastrous potato famine in the 1840's.

Irish population figures this century make depressing reading. The decline in numbers, largely due to emigration and lack of opportunity at home, began in the last century and by 1911 had cut the 8 5 millions who lived on the island in 1845 to half

Real change in 1960's

Self-government and the consequent efforts to provide jobs at home failed to remedy the situation to any important degree. Even as late as the mid-1950's two out of every three Irish school-leavers (high school graduates) went abroad to work.

The real change in the graph came in the period 1960-1965, when a small increase in population was returned. The latest figures indicate that this trend is continuing and increasing.

The main reason for what is in Ireland a dramatic change is certainly the increased economic activity generated by the late Seán Lemass when he became Prime Minister in 1959, and continuing under Jack Lynch.

The population of the Irish Republic is now as large as it was when the state was founded in 1922, and in addition the economy is geared for further growth. Also the 2.97 million enjoy a much higher standard of living than the same number did in 1922.

The most dramatic change in the population trends is the decline in the number of young people who are emigrating. This now runs at about 10,000 persons per year. Some 15 years ago the figure was as high as 50,000.

Increased job opportunity at home, provided in many cases by injections of foreign capital, has been the main reason for this change. But a declining attraction to the traditional centers of Irish emigration in Britain and the U.S. is also a cause. Irishmen going to either the U.S. or England in the 1960's often ran the risk of conscription.

Since the mid-1960's, it has become increasingly difficult for Irish citizens to enter the United States, while the leveling-off of living standards between the Republic and the United Kingdom has made opportunities in Britain less attractive.

There are interesting developments within the country also. Dublin, the capital, continues to grow far more quickly than the rest of the country and the areas near Dublin are prospering. The greater Dublin area now contains almost 1 million people —27 percent of the total population of the nation.

But Dublin's growth has not been quite as spectacular in the past five years and the greater part of the extra population is centered around other regional cities, which seem to be big enough to ensure continuing expansion without extra government effort. Cork, Limerick, Shannon, Waterford, and Galway all show considerable increases in population, and so do the areas around them.

The depressed areas of the west and northwest continue to lose population, but at a far lower rate than in former decades. If there is any lesson in the latest figures for the economic planners it is that special centers of growth will have to be established in these regions also

Losses slowing

More important, however, are the shifts in population within the country itself. The big increase in population in the Dublin area and around the other cities, and the decline in rural areas in the west and northwest means that some of the constituencies will have to be redrawn before the next general election.

This trend could cause difficulties for the government (Fianna Fáil) party, which is strongest in the rural western areas and tends to do less well in the cities. The increase in the urban vote should also help the Irish Labor Party, which is better organized in the cities and enjoys the cooperation, if not always the active support, of many urban trade-unionists.

By Nollaig O Gadhra
Special to The Christian Science Monitor

Dublin

STUDENT COMMENT NO. 24: Man and Water

- 90% of the weight of our bodies is water.

- We can lose up to 5 gallons of this water per day through perspiration.

- We consume about 4.5 pounds of water per day.

- Average water consumption in the world is approximately 10 gallons per person per day.

- Average water consumption in the U. S. A. is approximately 1, 800 gallons per person per day.

- Man can live without water for only about 5 days.

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STUDENT COMMENT NO. 25: Water Consumption Patterns

CONSUMPTION PATTERNS OF WATER

CONSUMPTION OF WATER IN THE CONTEMPORARY U.S. HOUSEHOLD	
Use	Amount (gallons/per capita/day)
Flushing toilets	20.5
Washing and bathing	18.5
Kitchen use	3.0
Drinking water	2.5
Washing clothes	2.0
General household cleansing	1.5
Watering the garden	1.5
Washing the car	0.5
One faucet drip	12.0
One toilet bowl leak	60.0

Source: Gordon M Fair, et al., *Water and Wastewater Engineering*, I, New York, John Wiley & Sons, 1966, Chapter V, pp. 13-15; and City of New York Department of Water Supply, Division of Water Conservation, unpublished data, 1967.

STUDENT COMMENT NO. 26: Will We Run Out of Water?

Our demand for fresh water may soon exceed our supply.

The amount of usable water in the atmosphere remains relatively constant, but demand for water, both in this country and throughout the world, is increasing sharply. The U. S. is particularly demanding of its water supply. In many nations of the world, the average daily consumption of water for all purposes (domestic, agricultural and industrial) is about 10 gallons per person. At present, the average daily consumption of water in the U. S. is approximately 1,800 gallons per person! We are presently using about 355 billion gallons per day in this country, mostly for agriculture and industry. The demand is expected to double or triple by the end of the century.

A large amount of additional water will be required just to sustain a rapidly growing population. Even if no new uses for water are developed, usage will probably double by the year 2000 in this country. Areas of Latin America, Asia and Africa where population is growing much rapidly may face an even more serious shortage of water.

This chart summarizes the increased demand for water by the three primary water users in this country:

	1900	1960	1980 (est.)
Industry	15 BGD	160 BGD	394 BGD
Agriculture	22 BGD	141 BGD	166 BGD
Municipal	3 BGD	22 BGD	37 BGD
TOTAL	40 BGD	323 BGD	597 BGD

BGD - Billion Gallons per Day.

At the rate indicated on this chart, we may well need a trillion (1,000 billion) gallons of water per day by the turn of the next century. The dependable supply of fresh water in the atmosphere is estimated at 650 BGD. Thus, the demand for water will match the supply within ten years (right around 1984!), and the demand will far exceed the supply by the year 2000.

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Lavaroni, Charles W., Lindberg, Lawrence A., and O'Donnell, Patrick A., Water Pollution, Addison-Wesley Publishing Co., Inc., Menie Park, Calif., 1971, "Water Shortage," pp. 14-15.

[1]p. 15

STUDENT COMMENT NO. 27: Water Wasters and Water Wastes

Make something readily available to someone in a seemingly inexhaustible supply, and he will soon learn to use it wastefully.

That is precisely what has happened with fresh water in this country. Farm families who had to lug all their water into the house from wells were not inclined to waste any. City families who can have as much water as they want with the twist of a faucet are much less conservative in their usage. In fact urban families with plumbing use almost six times as much water as farm families with wells. Ever since indoor plumbing became commonplace in individual homes, Americans have been squandering their precious water supply. Modern homes are equipped with more bathrooms, appliances, home laundries and other products which require water. Today each American uses at home approximately four times as much water as he did in 1900.

Walking hand in hand with the problem of increased water consumption is the problem of increased water pollution. The same city dwellers who use more water also contaminate the water supply more than ever before. Sewers from cities carry not only sewage, but detergents, DDT and a host of other pollutants from homes and businesses into the water supply. A large city consumes an average of 70 million gallons per day of water. It also adds 17 tons of organic suspended solids, 17 tons of organic dissolved solids, eight tons of inorganic dissolved solids and 60 cubic feet of grit to the water system -- DAILY.

However, despite the tremendous increase both in use of water and in pollution, municipalities still only consume about 10 per cent of the dependable water supply in the nation. The vast majority of the water is utilized by agriculture and industry.

Lavaroni, Charles W., Lindberg, Lawrence A., and O'Donnell, Patrick A., Water Pollution, Addison-Wesley Publishing Co., Inc., Menie Park, Calif., 1971, "Water Users," pp. 16-17.

STUDENT COMMENT NO. 28.

Water supply protection urged in St. Johns plans

Municipal officials bid start with eye on ecology

By LLOYD SHANNON

Environmentalists and proponents of the St. Johns River flood control project locked horns this morning as municipal officials made an impassioned plea that the governing board of the Central and Southern Florida Flood Control District (FCD) do something to assure South Brevard of a potable water supply.

Officials representing Melbourne, Satellite Beach, Melbourne Village all appeared before the board along with County Commission Chairman Lee Wenner and expressed concern over Lake Washington's capability of supplying South Brevard with all the water it needs now and in the future.

Wenner told the board he thought it "ridiculous to throw away all the money that has been invested in the St. Johns River flood control project, while observing "environmental control safeguards."

The FCD has spent approximately $20 million developing a system of reservoirs on the uplands of the river basin to provide Brevard with flood protection and a supplemental water supply, as well as providing water that can be used for irrigating agriculture areas primarily in Indian River County.

Work on the project has been stopped pending the completion of environmental studies.

Mayor Milton McGrath of Melbourne simply asked the FCD to do "Something. . . and as soon as possible," to provide Melbourne with a guaranteed supply of potable water.

Melbourne City Councilman Vernon Dicks expressed confidence that environmental problems the project may create can be taken care of in time. He asked the FCD to move ahead with the St. Johns River project speedily.

Satellite Beach Mayor Percy Hedgecock Melbourne Village Mayor Ray Henderson both urged the FCD to proceed with the project.

"I like to fish and hunt wildlife," Hedgecock noted, "but I like people better."

Henderson asked the board to do something to divert water being lost through canals back into the river.

Arthur Marshall, a member of the FCD board, said he would "remember the lessons of the Kissimmee" in any decision he makes concerning the project and emphasized the importance of using "natural systems" where possible. He said he was concerned about water quality but knew of no way to predict quality "in a managed water body."

Questions concerning water quality and the shipment of water south from the reservoirs to agriculture areas for irrigation purposes were raised by some officials and conservationists.

Bill Storch, the FCD's chief engineer, admitted there may be water quality problems.

"Surface water quality always varies," he said, but noted the engineers who built the Melbourne water plants and distribution system obviously took that into account from the start.

It was emphasized by Jack Malloy and other FCD officials that people will be the first priority when water use is considered.

"The assumption many people have that all the reservoir water is going to be used for irrigation purposes is wrong," Malloy pointed out. He explained discharges to agricultural areas would be regulated according to water levels in the river valley.

Margaret Scott appeared before the board in behalf of the South Brevard League of Women Voters and challenged the board about water quality. She also pointed out that the league was in favor of the St. Johns being placed in a single water management district.

New water management districts are being established throughout the state by the Legislature and there is a possibility that the Upper St. Johns River Basin will be made a part of the new St. Johns Water Management District. The basin has been a responsibility of the FCD for more than 20 years.

Mrs. Scott expressed fears completion of the project "could jeopardize South Brevard's water supply."

Water supply guard urged

Ret. Maj. Gen. Harry J. Sands, a former member of the FCD board, addressed a series of questions to the board. He asked if priorities could and would be made on the use of water in the basin and was advised by Malloy that priorities definitely would be set. Ed Dail, executive director of the FCD, said people would have "first priority."

"I want the people of the county assured their fears regarding the misuse of water are unfounded and I believe you have taken care of that," Sands told Dail.

Sands also asked if water quality will be assured before spillways in the upland reservoirs are closed.

Storch explained that while there was no way to build quality guarantees into the design of a project, there were operational procedures that could be used to guarantee quality. Storch explained how water is now being drawn down in one of the FCD's South Florida conservation areas in order to cleanse water stored in the area.

Storch noted during the meeting that there are water quality problems in Taylor Creek, the FCD's only completed impoundment area in Brevard County. Malloy, said that it is thought water quality will improve in the impoundment area with age.

Sands particularly stressed the need for flood control in the river basin, citing "devastating floods" which occurred in Brevard several years ago. Woertendyke took issue with Sands' use of the word "devastating" and charged that flood control issue was being used as "blackmail."

Melbourne City Councilman Dave Woertendyke expressed concern over water quality and the effect water discharged from the reservoirs might have on Lake Washington. "I know that people are not willing to pay a great deal more for water treatment."

Woertendyke asked the board if it could consider only the construction of a dam on Lake Washington and forget about construction of the reservoirs. Dail advised Woertendyke that the board couldn't approve such construction "because of the way things are now constituted."

Woertendyke also asked the FCD board "who is pushing the project?" and questioned why he always "saw the same faces" at recent meetings concerned with the project.

Three members of the Melbourne City Council opposed to the project would like to see the FCD build a dam on the lake and leave the reservoirs empty except in times of emergency.

Melbourne Times, February 16, 1973

STUDENT COMMENT NO. 29:

Officials Pore Over South Water Shortage

By DAVE THOMPSON
TODAY Staff Writer

Brevard legislators, county commissioners and Melbourne city councilmen have met to try and determine what action they'll take to provide adequate drinking water supplies for future South Brevard needs.

After the meeting, it still wasn't quite clear what the action will be.

"I think we need to formulate a united front on this so we'll have something to present when the flood control district meets here," Melbourne Mayor Milton McGrath told the assembled officials. "This thing has been talked about for 17 years, and there still hasn't been a solution."

The Central and Southern Florida Flood Control District (FCD) will meet in Melbourne Feb. 16 at the request of County Commission Chairman Lee Wenner, McGrath said.

Wenner said one answer to solving future South Brevard water needs would be comple - tion of reservoirs west of Melbourne already started by the FCD. This would include flooding of the Jane Green Reservoir and completion of spillways to control runoff in the St. Johns basin area, he said.

"I think we must look to water conservation, convince the FCD to go ahead with their programs and have the Legislature release funds to get these programs going," he said.

However, Melbourne Councilmen David Woertendyke and Ed Von Nordeck said they weren't sure the Jane Green FCD projects should be completed.

"I'm not at all thoroughly convinced the Jane Green Reservoir would be the answer to problems in this area," Woertendyke said. "I don't see how large quantities of poor water would be a solution."

Some biological studies have indicated the Jane Green Reservoir could be contaminated with organic nutrients, causing blooms of toxic algae, if the FCD project is completed.

"I don't see how we could draw conclusions on the good or bad water yet," County Commissioner Joe Wickham said. "Every area that is flooded has poor quality for a time after that. I do know that we'll be in real trouble if some water isn't saved."

Woertendyke said he felt some of the problems could be solved if population growth was limited in South Brevard and some sort of controls placed on outside developers. But other officials said they did not feel this was practical.

"There's no way we're going to stop people from moving here," Councilman Vernon Dicks said.

Some of the officials said the FCD would have to be convinced to go through with the South Brevard projects, since there is a good chance Brevard will be pulled out of the FCD and placed in a new St. Johns Basin Water Management District by state legislators.

Brevard Rep. Jack Shreve said it isn't absolutely certain yet how the new districts will be organized.

However, retired Gen. Harry Sands, a former FCD board member, said the FCD hadn't held up work on the South Brevard projects in the first place.

"They've been waiting for word on an Army Corps of Engineers environmental impact study, which might come out in three or four weeks," he said. "And money that was set aside for the Brevard projects has been re-allocated during that time."

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Today, February 8, 1973

STUDENT COMMENT NO. 30: Water Resources Questions

1. Locate as precisely as possible the area (watershed) in the State or County where the rain falls which is used in your household. Over how large an area does this rainfall occur?

2. In what lakes or reservoirs is this water collected? How have these reservoirs been improved?

3. Where is the water purification plant for your area located?

4. How is this water treated in order to purify it? What is removed and how is it removed? What is added to the water and why are these substances added?

5. How is this water distributed to your home?

6. Which governmental agencies are responsible for getting good and sufficient water your home? For which aspects of the process is each agency responsible?

7. What specific problems have resulted from the need for a city to obtain large quantities of purified water and how might these problems be resolved?

STUDENT COMMENT NO. 31: Caution: Breathing May be Hazardous to Your Health

Field trips have always been popular in school, especially elementary school. Students crowd onto buses to visit museums, parks, theaters and other sources of cultural enrichment or recreation. Japan has recently come up with a rather unusual kind of field trip -- busloads of city children are being taken out to the country so they can see what clean air looks like!

Although the idea of taking a field trip just to find some fresh air may at first strike you funny, if you think about it the humor is rather grim. We may, in fact, be laughing all the way to the cemetery. All around the earth, but especially in the United States and in Europe, pollution is increasing. In Mexico City, the flowers on the central boulevard have to be replaced every two months, because they die of air pollution. In Italy, people have learned to take the train to Milan during the winter smog season, because the situation is so bad that planes often can't land due to poor visibility. In Birmingham, Alabama, there have been causes of nightmares induced by sulphur dioxide, wherein the person dreams he is being asphyxiated (suffocated). That dream may soon become a reality.

Air Pollution Kills

As soon as man faces that fact, he may be able to do something about it. It seems that people in this country (and around the world) are finally waking up to the urgent crisis which has been thrust upon us in the 1970's as a result of our extensive industrialization during the previous four decades. In the 1930's, for example, Japanese children sang proudly of "The Flames of Belching Smoke," as the nation rapidly industrialized prior to World War II. That song is no longer very popular in a country where some of these same children may have been among 20 "pollution patients" who have died in Kawasaki alone since February, 1970. In Alabama, mill workers used to say, "Dirty skies mean full lunch baskets." Today's mill hands, listening to their children wheeze with asthma caused by air pollution, are no longer echoing that refrain when they look at the sky.

A Worldwide Problem

Although air pollution is especially serious in the United States and Western Europe, it is becoming a

worldwide problem. In general, the more industrialized a nation becomes, the greater its air pollution problem. It is therefore no surprise that the U. S. is in "first place" in the air pollution department. Of the 28 cities listed in a Los Angeles Times study of the world's worst pollution centers, the U. S. has no less than nine -- New York; Pittsburgh; Washington, D. C. ; Birmingham, Alabama; New Orleans; Houston; St. Louis; Chicago and Los Angeles. Europe has six: London and Sheffield in England; Rotterdam in the Netherlands; Paris, France; Ruhr, West Germany; and Milan, Italy. In the Far East, the six major pollution centers are Tokyo, Japan; Seoul, South Korea; Tiapei, Taiwan; Saigon, South Vietnam; Bangkok, Thailand; and New Delhi, India. South America has four severe pollution centers -- Rio de Janeiro and Sao Paulo in Brazil; Buenos Aires, Argentina; and Santiago, Chile. The other focal points of pollution in the world are Ankara, Turkey; Moscow; and Mexico City.

The Los Angeles Times study pointed out five major effects of air pollution, and listed six primary causes. The major effects were:

1) On health. In the last 10 years, at least 1,000 deaths have been attributed directly to air pollution, and countless thousands more were probably hastened by air pollution.

2) On nature. Plants, flowers and trees in cities have perished, and many species of birds and insects have fled.

3) On aesthetics. Much beauty, both natural and man-made, has been lost or tarnished. Familiar views have faded, pleasant odors have been turned into horrible smells, and famous buildings and statues are being discolored and corroded.

4) On life-styles. In soot-colored cities, people have begun to wear soot-colored clothing. Home-owners have given up on repainting homes stained by industrial effluent. People have flocked from the cities to the suburbs to avoid smog, but they only create more smog when they commute to and from work by automobile.

5) On the weather. Sunshine is a rare event in some cities, and the air pollution index has become a routine part of the weather report. (Can you imagine turning on the radio in the morning to see whether or not you had to wear your gas mask to school that day?) Polluting particles may cause increased rainfall downwind of industrial complexes, by seeding the clouds. Ironically, fair and calm weather has become unwelcome in many cities, because it causes a build-up of smog. Chilly, blustery days are actually preferred in many places, because at least the raw weather provides a brief relief from the smog.

The major causes of air pollution are:

1) Industrial emissions. Carbon monoxide, sulfur dioxide, oxides of nitrogen and acid gasses are most widely existing.

2) Smoke from high-sulfur fuels. Sulfuric oxides pour into the air from the combustion of both coal and oil with a high sulfur content. Latin American and Middle Eastern mills are high in sulfur -- up to 5% -- and the removal of this substance may increase the cost of the fuel by up to 10%.

3) Particulates (very small pieces). Coal particulates can be controlled if "smokeless" (treated) coal is used, but there are many other sources of solid particles -- trash incinerators, steel mill effluents (out flow), dust from rubber and grain-milling plants, and natural dust from land stripped of vegetation by farming or erosion.

4) Carbon monoxide. This invisible, odorless poisonous gas comes largely from automobile exhaust. It is a threat in nearly every city that has heavy traffic.

5) Lead. Lead oxides are highly toxic (poisonous) substances produced in the combustion of gasolines containing lead additives to reduce engine knock.

6) Photochemical smog. This comes from a complex chemical reaction involving hydrocarbons and nitrogen oxides from the internal combustion engine. It is activated by sunlight. Many oxidants are included in smog; probably the most common is ozone, a high corrosive form of oxygen (O_3).

The destructiveness of these types of air pollution depends on factors such as the geography of the region surrounding the city (do mountains trap the polluted air?); meteorology (sun, winds, temperature inversions); industry (how much, and how well is it regulated?); population density, and the number of people who use cars (and how often).

Public Awareness and Cooperation Needed

" 'Smog is a societal problem," said Dr. John Middleton, deputy assistant administrator of air programs for the federal office of air programs in Rockville, Md, 'It must be approached that way.' "

As serious as air pollution is, it CAN be corrected -- if there is strong public pressure and cooperation. A perfect example of community action against air pollution can be seen in the case of London. The British capital was one of the first places in the world to be industrialized, beginning as early as the American Revolution. For 150 years, the city was shrouded in a steadily worsening haze of coal smoke. London fogs became famous, but

they were more than just fogs. Bits of coal ash from home-owners' open coal hearths clogged the air, retaining moisture and making the fogs persist longer. As industry grew, it spewed more soot and irritating sulfuric oxides into the atmosphere. London became a grimy gray city. Scores of species of birds disappeared. Respiratory illnesses increased. The turning point came in 1952. Trapped by an air inversion, smog paralyzed London for four days. Before it finally lifted, some 4,000 people with illnesses had died due to complications caused by air pollution -- deaths which normally might have been long delayed. Great Britain awoke. In 1956, the Clean Air Act was passed, ordering strict smoke control. Industrial emissions were curtailed. Large areas, including London, were declared "smokeless zones." The old open hearths were banned, and home-owners had to use gas, electricity or specially treated smokeless coal. The strict measures paid off. Gradually London has emerged out of the haze. Sunshine increased by an average of 40%, and in December, traditionally the worst month for smog, it increased by 70%. Gardeners found it possible to grow plants which had been killed by the smog. Birds returned. The polar bears in London Zoo were white instead of gray. Londoners began to wear lighter-colored clothing. The new regulations also benefited Sheffield, once the dirtiest of Britain's manufacturing centers, and now one of the cleanest. One of the techniques used to clear Sheffield was to build 900-foot smokestacks from some of the mills, thus dispersing the irritating sulfur dioxides in the upper wind currents, rather than allowing them to settle on the ground. Clearly, this solution has its limitations, because the pollutants could fall elsewhere and become someone else's problem. Nevertheless, England's actions have clearly demonstrated that even if air pollution can't be eliminated, it can be controlled.

Proof that air pollution can be brought under control can also be seen in the case of Pittsburgh in this country. Known as the "Smoky City" during the 1930's due to its steel mills, the western Pennsylvania metropolis came squarely to grips with its problem after World War II, and it has succeeded in reducing air pollution to lower levels than many other cities, without heavily curtailing its industry.

The examples of London and Pittsburgh are encouraging. Other communities need to follow suit -- and rapidly. It's a matter of life and breath.

--Dial Torgerson, Los Angeles Times Dispatch, "Pollution: Yellow Cloud from Space, Killer on Earth," printed in Orlando Sentinel, Sunday, January 23, 1972, p.18A.

STUDENT COMMENT NO. 32: Natural Air Pollutants

There are two basic classes of air pollutants--natural and man-made. Although natural pollutants are not generally considered in discussing the problem of dirty air, many particles such as water, dust and pollen, and some gases released into the air during natural processes can become a problem because of changes in temperature, the amount of sunlight or in the type and amount of plant growth. Even though natural pollution cannot be controlled to any appreciable degree, neither can man afford to ignore it entirely. Five major sources of natural pollution are volcanoes, forest fires, soil particles, salt particles and cosmic dust.

When a volcano erupts, vast quantities of smoke and debris are hurled into the air. A powerful eruption may discharge 100 billion cubic yards of particles into the atmosphere. Some may rise to a height of 13 miles and take years to drift back to earth. It is possible for such particles to affect the earth's climate by blocking out some of the sun's rays and causing a gradual cooling of the earth's atmosphere. However, the significance of volcanoes as a source of air pollution is still a very controversial scientific topic. Some scientists argue that the amount of particles released by volcanoes in proportion to particles from other pollution sources is insignificant. Others feel that volcanoes may be a more serious source of pollution than previously thought.

Forest Fires Reduce Visibility

Forest fires are, in a sense, both natural and man-made; they occur in nature, but more often than not they are started by the carelessness of man. The greatest significance of forest fires is the amount of timber destroyed. The U.S. National Forest Service estimated that from 1954-1963 a total of 1,200,000 forest fires in the United States consumed over 6 million acres of forest. However, smoke from these fires can add substantially to air pollution. Usually this effect is felt only in the vicinity of the fire, but in the case of major fires a significant danger may be posed for motorists and aviators in the form of reduced visibility.

Under certain conditions, large quantities of soil particles can be swept into the atmosphere by winds. Such sand and dust storms result from drought, the absence of plant growth, and an abundance of fine, powdery soil. The process of wind picking up soil particles is known as saltation. These particles remain

in the atmosphere until they are brought back to earth by gravity or with precipitation. Saltatation is a problem in windy areas where topsoil has been disturbed; strong winds blowing over recently-plowed fields can carry off much of the topsoil. In the 1930's drought and over-cultivation in wide areas of the Midwest led to such severe saltation that the entire region became knows as the "Dustbowl." Problems of natural air pollution from saltation are reduced three factors: 1) adequate rainfall, 2) larger particles of soil, and 3) aboundant plant growth. Man must depend primarily on the third factor in his effort to control the problem.

Salt particles enter the atmosphere when ocean waves crash against the shore, throwing small water droplets into the air. Many of these particles move to high altitudes on currents of rising air and are then swept inland. Eventually water droplets form around the salt particles and they return to earth as rain. Salt particles themselves are invisible, but their effects on paint and automobiles are obvious. Air pollution caused by salt particles is a serious problem in many coastal areas, especially along the beach. It is not a serious problem for those living further inland.

The Earth is Bombarded with Cosmic Dust

The other major type of air pollution which exists in nature comes from outside the earth's atmosphere. As the earth orbits around the sun it passes continuously through large clouds of cosmic dust. The larger particles are visible from the earth as "shooting stars." Millions of these meteors are visible to astronomers each day. It has been estimated that at least 1,000 tons of these tiny particles enter the earth's atmosphere each year, but because they are spread equally over the earth's surface, the overall effects of cosmic dust on air pollution are probably not serious.

None of the five major natural sources of air pollution poses a serious threat to health. It is important to be aware of them, however. Even if man had never entered the picture, there would be no such thing as perfectly "pure air."

--Charles W. Lavaroni & Patrick O'Donnell, Air Pollution, Addison-Wesley Publishing Co., Inc. Menle Park, Calif., Ch. 2, "Air: A Vital Resource," pp. 9-35.

STUDENT COMMENT NO. 33: Experiment 1 • Particles in the Air

PURPOSE: To observe particulate contamination in the air.

MATERIALS:
1. several white index cards
2. a jar of Vaseline
3. a roll of Scotch Tape
4. a magnifying lens

BACKGROUND: Millions of different kinds of particles are dumped into our atmosphere each day. Some of these particles come from natural sources: soil particles picked up by the wind, salt particles from ocean spray, and smoke from forest fires and volcanoes. Many of these airborne particles come from man's activities. The burning of vast amounts of fuel for heat and power, construction and manufacturing activities of all kinds, the disposal of wastes, all add solid pollutants to the air.

Many cities are covered by a gray cloud of dust particles floating a mile or so above the ground. According to scientists, these dust clouds absorb 20% to 50% of the sun's rays causing the daytime to be cloudy and dull.

Measurements once made in Pittsburg showed that an average of 610 tons of dust fell each year on a single square mile of the city. The dust in other cities may be even worse. In the center of Tokyo, 57 tons of dust per square mile were measured in one month.

PROCEDURE: What is it like where you live? Here's how you can begin to find out.

1. Number the index cards.
2. Smear a very thin layer of Vaseline in the center of each card.
3. Tape the cards in various places around the school, both inside and outside.
4. After one day collect the cards for observation.

5. Use a magnifying lens or a low power microscope to check on the number of particles.
   a. Only count those that you can easily see, because there will be many more that are too small to see without a more powerful lens.
   b. Observe the kinds of particles, their shapes, colors and sizes.

CONCLUSION: Where do you think the particles come from? How might you explain some of these differences? Would you expect the weedends to have more or less dust than the weekdays? Why? Write a paper explaining your answers to these questions and other results of the experiment.

STUDENT COMMENT NO. 34: Experiment 2 • Air Pollution and Automobiles

PURPOSE: To observe pollutants in automobile exhaust.

BACKGROUND:

1. Round discs of filter paper can be obtained from a science instructor.
2. Encourage student variation of the basic trial. Obviously a black ring of carbon compounds and oil will stain the paper. Interesting comparisons can be made but the variables must be held constant. For example it might be interesting to compare cars in general but the experiment can be made more precise by having control over as many variables as possible.

PROCEDURES:

1. Using filter paper or some porous white paper, place the paper over the tail pipe of a running idle car engine for a period of 10 seconds.
2. Observe the results.
3. Compare the results of other trials of different make automobiles. Note such differences as age of auto, number of horse power, etc.
4. Observe the results from the cars using different grades and brands of gasoline.

CONCLUSION: Write a paper explaining the results of your experiment.

STUDENT COMMENT NO. 35: Experiment 3 • Airborne Particulates

PURPOSE: To determine the density of smoke by the use of Ringelmann charts.

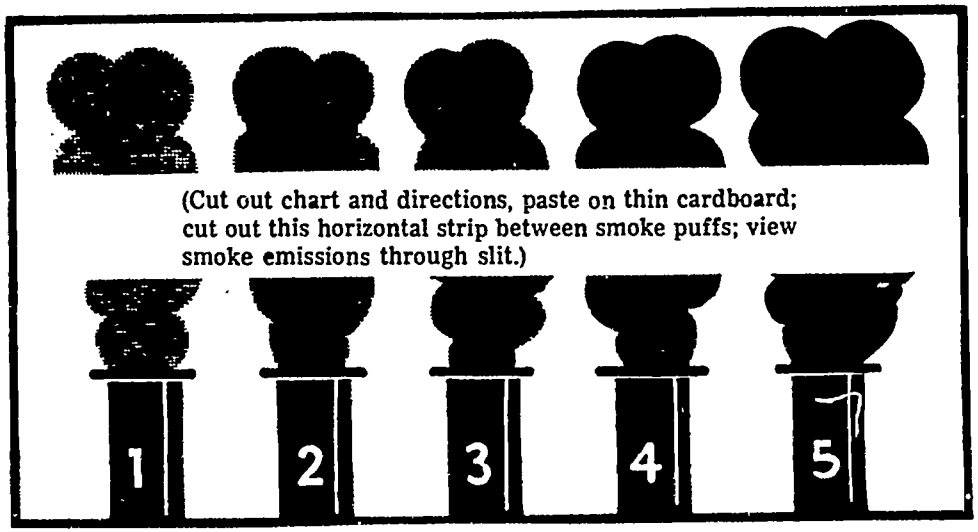
BACKGROUND: In the burning of any material if complete combustion takes place the by-products are carbon dioxide and water vapor. The products are colorless and harmless. In actuality, it is usually impossible to burn any product without some other by-products than CO_2 and water vapor even if excessive oxygen is supplied. Thus, the unburned carbon particles combine with other gases to produce various shades of gray.

To gauge the amount of pollution being discharged a Power's Micro-ringelmann or a chart can be used in a series of one through five. A copy of a Ringelmann chart can be found on the last page of this Comment. Ringelmann charts may be ordered from science equipment supply companies, such as Edmund Scientific.

PROCEDURE:

1. Select site to be measured. Stand more than 100 feet from site. Make sure the stack or site background is clear of buildings.
2. Hold the Ringelmann's chart by the right hand corner between thumb and index finger with reproduced grids toward the stack.
3. Face the stack and hold it at arm's length. Move the chart back and forth until the smoke matches the shade of one of the pairs of grids.
4. Observe over a period of time using increments of $\frac{1}{2}$ minute for 15 minutes.
5. Record number of observations and each Ringelmann number.

CONCLUSION: Write a paper explaining the results of your experiment.


(Cut out chart and directions, paste on thin cardboard; cut out this horizontal strip between smoke puffs; view smoke emissions through slit.)
1
2
3
4
5

STUDENT COMMENT NO. 36: Experiment 4 • Air Pollution and Plant Life

PURPOSE: To observe effects of air pollution on plant life.

BACKGROUND:

1. Weeds may be collected from either school or home site. Germinated flower seeds may be preferred.
2. The seal around the cup can be made tight if the soil is used as a holder or you can simply use rubber bands.
3. Exhaust fumes may be hot enough to cause results, therefore it may be wise to use a vacuum hose to reduce temperature. Try to avoid too much heat!
4. Two similar plants should be used in order to replace those lost by diffusion through the Saran Wrap. Don't forget to water the plants!

PROCEDURE

1. Transplant two similar plants into separate cups.
2. Label the two separate cups A and B.
3. Wrap cup A in Saran wrap so that a dome is formed over the plant.
4. Cut a hole in the Saran Wrap so the hole will fit over a car exhaust pipe (or vacuum cleaner hose — to reduce heat). Crank the car engine and allow the fumes to enter the dome for about one minute.
5. Quickly seal the hole with another piece of Saran Wrap.
6. Repeat the procedure for several days. (During this time conduct Experiment 5 on temperature inversion).
7. Observe any changes in the physical appearance of the cup A plant and compare with the cup B plant.

CONCLUSION: Upon completion of the experiment, write a paper explaining the results.

STUDENT COMMENT NO. 37: Experiment 5 • Temperature Inversion

PURPOSE: To observe the effects of a temperature inversion

BACKGROUND: Under normal conditions, when the atmospheric temperature decreases rapidly with altitude. an air mass is unstable. Pollutants, released at ground level, are carried by vertical turbulence high into the cooler air above. However, when the air at or near ground level is cooler than the air above, a stable air mass is produced. While this temperature inversion prevails, vertical movement of the air mass is restricted. Contaminants emitted at ground level accumulate around their sources. The concentration of pollutants continues to build until the temperature inversion ends. The effects of a temperature inversion can be demonstrated with a model system.

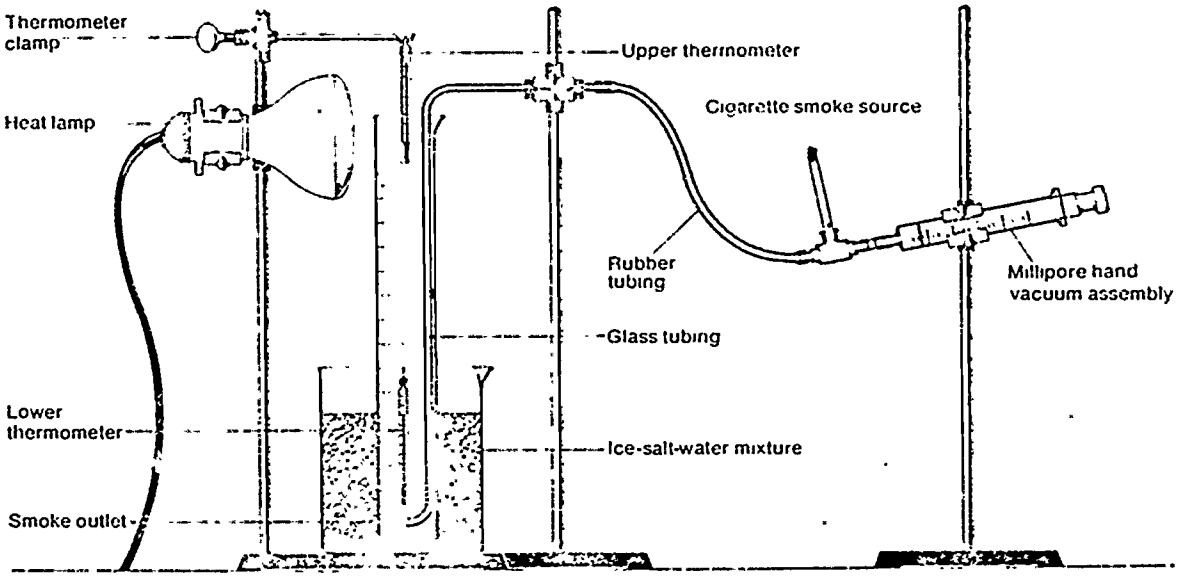
MATERIALS:

1. 1 liter graduated cylinder
2. 2 or 3 liter beaker
3. mixture of ice, salt, and water
4. 2 thermometers
5. glass tubing with elbow joint
6. rubber tubing
7. string or thread
8. ring stand with thermometer clamp
9. heat lamp with clamp
10. Millipore Hand Vacuum Assembly
11. cigarette

PROCEDURE:

1. Set up the apparatus shown below. Do not activate the smoke source or the heat lamp until the ice-salt-water mixture has cooled the air in the lower portion of the graduated cylinder.
2. Use the heat lamp to warm the air in the upper portion of the graduated cylinder.
3. When a significant temperature difference exists between the upper and lower regions of the cylinder, light the cigarette. Slowly introduce smoke into the bottom of the cylinder.

4. Observe the distribution of smoke within the cylinder.
5. After a dense layer of smoke has formed inside the cylinder, carefully remove the beaker containing the ice-salt-water mixture. Note the resulting temperature changes and the effect on smoke dispersal. (To speed this process, move the heat lamp closer to the base of the graduated cylinder.)
6. Demonstrate the dispersal of smoke under normal conditions. Use the heat lamp to warm the air in the bottom of the graduated cylinder to a higher temperature than the air in the upper portion.



Model demonstrating the effects of a temperature inversion.

CONCLUSION: What is the minimum temperature difference necessary to maintain a stable layer of smoke in the graduated cylinder? Does the extent of the temperature difference between the upper and the lower regions of the cylinder greatly affect the upward dispersion of smoke? What natural situations were being simulated both prior to and following the removal of the ice-salt-water mixture?

Write a paper explaining your answers to these questions and other results of the experiment.

--- A Guide to the Study of Environmental Pollution, William A. Andrews, ed., Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1972, pp. 230-232.

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STUDENT COMMENT NO. 38: Ways You Can Help Clean Up the Environment Now

AVOID WASTE IN THE HOME AND WHEN SHOPPING

1. Use disposable paper and plastic goods only as necessary.
2. Make garbage compact. Flatten cans, boxes and cartons or stack them inside each other to conserve space.
3. Be sure the garbage can lid is tightly closed to discourage insects and animals from being attracted to the contents.
4. Do not litter. This is the easiest pollution to stop.
5. When possible, try to buy one large-size product rather than individual servings or individually wrapped products. It can be less expensive and less wasteful.
6. Use a strong mesh shopping bag instead of a paper one.
7. Wash and reuse plastic bags and containers. Conserve materials rather than throwing them away.
8. Return wire hangers to the cleaners.
9. Try to buy good-quality, long-lasting toys. Broken toys add to disposal problems.
10. Pack children's lunches in lunch boxes.
11. Try to buy toys that are not excessively packaged.

USE HOUSEHOLD CLEANING PRODUCTS CAREFULLY

12. Use detergents with care. Phosphate detergents can upset the ecological balance of aquatic life. Substitutes are being developed, but until they are perfected you may wish to use a detergent with little or no phosphate. Use the minimum measured amount effective.
13. Use soap for washing all but heavily soiled items, if you live in a soft-water area.
14. Use ammonia, toilet-bowl cleaners and chlorine bleach with care. Mixing them can cause dangerous gases to escape.
15. Use paint-on oven cleaners instead of sprays. While both are harsh, sprays can be easily misdirected and may cause respiratory problems, skin and eye damage.
16. Do not use products that contain solvents (petroleum distillates) if alternates are available, such as water-based paints.

CONSERVE WATER

17. Run water only as you need it when brushing teeth, shaving, washing hair or dishes.

18. Keep a jar of water in the refrigerator to avoid the need of running water from the tap to cool it.
19. Never drop trash in the toilet. This causes sewage overflow and can lead to expensive repairs.
20. Take reasonably short showers instead of baths. The average bath uses more water than a seven-minute shower.
21. Repair leaking faucets immediately.
22. Ask your plumber the next time he is in your house to set toilets for the minimum amount of water.
23. Do not overwater lawns and gardens. Most require only one deep watering each week.

CONSERVE ELECTRICITY

24. If you have an air conditioner, turn it off if no one will be home. Set it at moderate rather than high.
25. Turn off lights in rooms not in use.
26. Try to avoid using major appliances in late afternoon and early evening--the periods of peak demand.
27. Run the dishwasher and washing machine with one full load rather than several small ones.
28. Try to save once-in-a-while jobs, such as vacuuming or working with power tools, for the weekend, when power demands are usually low.
29. Turn off electric appliances when not in use.
30. In hot weather, adjust blinds and shades to keep out the sun. Air conditioners will then have less work.
31. Turn house heat down at night in winter, between five and ten degrees lower than daytime temperatures.

AVOID EXCESS NOISE

32. Keep radio, TV, or phonograph tuned to a reasonable level.
33. Do not buy excessively noisy toys for children.
34. Keep household appliances in good condition.
35. Install inexpensive, thick, perforated, sound-absorbing wall or ceiling panels in particularly noisy areas.
36. Do not use your car horn unless necessary.

KEEP YOUR GARDEN "NATURAL"

37. Build a compost heap. Include vegetation, such as hedge and lawn clippings and leaves. County agricultural agents can provide specific instructions.
38. Avoid the use of persistent pesticides. These include the chlorinated hydrocarbons (aldrin, dieldrin, endrin, heptachlor, chlordane, and lindane) plus commercial compounds containing arsenic, lead, or mercury.

39. Buy helpful insects--such as ladybugs, praying mantises, aphis lions, and parasitic wasps--to control destructive garden pests. All are reasonably priced.
40. Carefully follow directions for garden sprays.
41. Use organic fertilizers (available from your nursery) under and around trees and shrubs.
42. Strong-smelling herbs, such as mint, sage, and basil, repel insects and help keep down your use of pesticides.

REDUCE AIR POLLUTION

43. When possible, use mass transit systems, walk, ride a bicycle, or form car pools to help reduce the number of cars--a major source of air pollution--on the road.
44. Keep your car in good operating condition.
45. Do not idle the car unnecessarily.
46. Consider buying a low-horsepower car.
47. Check that your car is equipped with one or more emission-control units and that they operate properly.
48. Use a hand mower if your lawn is small. Power mowers emit gas fumes.
49. Do not burn leaves.
50. Never use charcoal indoors. When burned, it releases poisonous gases.
51. Do not burn plastic materials. Some release noxious gases when improperly incinerated.
52. Do not use coal, leaves, or garbage in the fireplace.

RECYCLE PAPER, GLASS, ALUMINUM

53. Buy products in returnable bottles.
54. Wash and reuse jars and jar covers for storing and freezing.
55. Bring nonreturnable bottles and jars to reclamation centers.
56. Save paper! Make bundles of newspapers and flatten cardboard boxes. Ask environmental groups whether there is a nearby collection center.
57. Save cans for recycling.
58. Encourage manufacturers to establish recycling centers.
59. Encourage money-raising programs for young persons and/or organizations through collecting cans, bottles, paper, and glass for recycling.
60. Be willing to purchase and use recycled products.

HELP MAKE YOUR COMMUNITY BETTER

61. Be informed. Know your community's laws concerning pollution control, zoning, building regulations and beautification standards.

62. Write to pertinent officials about your concern and ask them what they are doing about environmental problems that interest you. Find out how you can help.
63. Help organize a neighborhood citizen's group with support from local environmental groups.
64. Work with existing groups for pollution control.
65. Encourage neighborhood clean-up campaigns.
66. Suggest to local environmental groups that they urge municipalities to improve sewage treatment and solid-waste disposal facilities.
67. Encourage interested young people to consider careers in the environmental health field.
68. Let local candidates know you are interested in pollution control and ask about their programs.
69. Bring old usable clothing to thrift shops for resale, or donate it to charitable organizations.
70. Donate magazines and paperbacks to hospitals.
71. Try to get an environmental shelf established in local and school libraries.

USE FEWER DISPOSABLE WASTES (Average 1800 lbs. per person per year)

72. Buy returnable bottles instead of plastic--milk and drinks.
73. Eliminate as many of your paper products as possible.
    a. Use sponge or cloth instead of paper towels.
    b. Use washable diapers --not disposable ones.
    c. Use washable glasses and plates instead of disposable ones.
    d. Use cloth napkins instead of paper ones.
74. Start a compost for fertilizer and mulch. Vegetable scraps - leaves - grass - etc.
75. Reuse paper bags.
76. When using tissue, paper towels and napkins--use white, it deteriorates faster than the colored.

RECYCLE AND REUSE MATERIALS WHERE POSSIBLE

77. Save all glass. Take to local collection point. (Brevard Recycling Center, 440 Railroad Avenue, Cocoa, Florida. Saturday, 8:00 A. M. — 5:00 P. M.)
78. Save all aluminum cans. (Take to Carroll Distributing Company, 256 Olive Street, Cocoa.)
79. Save all paper. (Take to East Coast Paper, State U. S. 1, Cocoa.)

CONSERVATION AND OUR ENVIRONMENT

80. Use only recommended amount of detergent.

81. Use low phosphate detergents.
82. If soft water, use soap or less detergent.
83. Use baking soda instead of strong commercial cleaner.
84. Reuse plastic containers.
85. Reuse foil and disposable aluminum containers until not usable and then save them for recycling.
86. Use only necessary amounts of fertilizer.
87. Use only necessary amounts of insecticides.
88. Avoid excessively packaged products.
89. Walk or ride a bicycle instead of driving when possible (improves health, air, and budget).
90. Drive less--pool rides; plan trips when driving to avoid unnecessary trips (cars cause 60% of air pollution).
91. Keep car tuned and mufflers repaired and avoid acceleration and sudden stops. Do not let motor idle while waiting for someone.
92. Don't smoke.
93. Conserve use of electricity:

    a. Wash clothes only when needed.
    b. Run dishwasher and washing machine only with full load.
    c. Do not leave the water running when you brush your teeth.
    d. Shower - wet - turn off shower - soap - rinse off.
    e. A tub need not be full to get a good bath.
    f. Don't use a flush toilet to dispose of a cigarette butt, each cycle uses about three gallons of water.
    g. Have faucet drips and other leaks repaired promptly.
    h. Limit car washing--hand washing takes less water.
    i. Keep a pan in the sink--much water can be reused for watering plants.

94. If every person in the city of Orlando were to place a brick in their toilet tank--(displacing water and using less to flush toilet) then 30,000 gallons of water would be saved daily.
95. Plant a tree. While humans inhale oxygen and exhale carbon dioxide, trees take in carbon dioxide and discharge oxygen, greatly helping to purify the air.

Brevard County Extension Homemakers Council

STUDENT COMMENT NO. 39:

3 Cities Set Growth Limits

BOCA RATON (UPI) Three small cities have taken on the forces of industry and two big land development corporations in attempts to cure growing pains and preserve the quality of life on Florida's Gold Coast.

The battle has been joined in Boca Raton, Hollywood and Hallandale. The eventual outcome may require a land mark decision from the U.S. Supreme Court and set a pattern for many suburban cities.

The three municipalities are trying two different approaches, but the goal is the same: Limit the number of residents in order to maintain the quality of life.

BOCA RATON has adopted a city charter to limit to 40,000 the total number of dwelling units within the city's limits. Hollywood and Hallandale have passed ordinances to restrict the population density per acre.

Both approaches confront the courts with further interpretation of the Fifth Amendment to the U.S. Constitution which says: " . . . nor shall private property be taken for public use without just compensation."

None of the three cities plan to condemn disputed land and pay what the owners think it's worth. The cities couldn't afford the hundreds of millions of dollars such condemnations would cost.

BUT AT THE samt time, the city fathers are telling the land owners they cannot develop the full potential they expected of their property.

Hollywood and Hallandale are in Broward County, one of the fastest growing counties in the nation. It adds more than 41,000 new residents per year. Boca Raton is to the north in Palm Beach County, where the mushrooming growth is spreading rapidly.

At Boca Raton, Richard Mayo headed a "Citizens for Reasonable Growth" movement which successfully petitioned for a charter referendum. It passed 7,722 to 5,626 votes Nov. 7.

"PEOPLE WANT TO keep Boca Raton a low density city," Mayo said. "That is what caused them to come here initially."

Hallandale received bad news at a recent public hearing from planning consultant Walter Sachs, Philadelphia.

"This community is indeed at a crossroads in its development," Sachs said. "If uncontrolled, we would predict a decided and rapid decline in the quality of life in this community."

Hollywood's commissioners were slapped individually with a $54 million damage suit for trying to dampen the population explosion.

THE SITUATION in the three cities at present:

BOCA RATON — Has a population of 33,000-37,000 persons living in 14,000 dwelling units built on 16,000 of the city's 44,000 acres. Councilman Norman Wymbs, father of the "growth cap" amendment, said the total of 40,000 dwellings would limit Boca Raton's population to about 105,000. Unrestricted, he said it might go over 200,000.

HALLANDALE — Only one mile wide and 2.5 miles long, the town has 2,000 vacant acres left. Consultant Sachs said if 20 units per acre were permitted on the vacant property, Hallandale would wind up with an average of 55 persons per acre, which is "two and a half times the current density of San Francisco."

HOLLYWOOD — Once a small "bedroom community" lying between Miami to the south and Fort Lauderdale to the north, now has a population of 102,000 in its roughly six-by-six mile square municipality stretching back from the ocean.

Boca Raton's growth law has been taken to federal court on constitutional grounds by the huge Arvida Corp., Arvida founded by the late Arthur Vining Davis, who also founded Alcoa, had its plans for development of University Park sharply restricted by Boca Raton's population throttle.

Orlando Sentinel Star. February 20, 1973

TEACHER COMMENTS

TEACHER COMMENT NO. 1 : Living/No -Living?

One of the hardest things for a student to do is to decide what is considered biotic or abiotic. If biotic is defined as living or recently living, it must be determined what constitutes life.

Life involves ten basic processes that are integrated into a single product, that of living. If any of these functions are absent, then the object being investigated is not alive.

The ten elements of life are as follows:

1. Nutrition (food getting)
2. Locomotion or motion
3. Irritability (sensitivity)
4. Digestion
5. Absorbtion
6. Assimilation
7. Circulation
8. Secretion
9. Excretion
10. Reproduction

This is an all inclusive list of elements. Other scientists use lists of varying size but most place two or three of these basic elements into other encompassing categories.

TEACHER COMMENT NO. 2: Evaluating Small Group Work

Many teachers refuse to incorporate small group work in their classrooms because they lack a satisfactory procedure for evaluating the outcome of such efforts. For the purpose of this unit of study, we suggest the use of the following process for checking the results of groups investigating each Inquiry Question. Use only where it is practical to do so.

1. At the end of the study of each Inquiry Question, there will be an exercise in the Learning Activities column entitled Check I. Q. At this point have each individual within a small group write out what he thinks is the answer to the Inquiry Question, by filling out the upper half of the I. Q. (Inquiry Question) Check in Student Comment No. 1 , Page 48.
2. Teacher collects I. Q. Check sheets and gives to a different small group for grading.
3. Class members will:
   a. Have in front of them a copy of class conclusion for the Inquiry Question arrived at during the Investigations.
   b. Decide how many total grade-points should be possible for the proper response to the Inquiry Question.
4. Each small group will compare the answer sheet handed it with class conclusion and then fill out that lower half of the I. Q. Check form. Experience has shown that more honest and serious evaluations are made when students do not know who is checking whose paper. The name of the checker on the I. Q. Check form is for the teacher only.
5. Return I. Q. Checks to teacher who may reveal scores to students.

If this method of evaluation is employed, it would be essential for students to remain in the same small group until completion is made of all investigations for any one Inquiry Question.

TEACHER COMMENT NO. 3: Large Group Discussion • Evaluation

The following checklist is offered as an example of a device which may be used to lend a degree of objectivity to evaluating student participation in class discussions. The teacher may involve students in the evaluative process by devising a rotation system whereby two or three students would evaluate class members during class discussion periods.

When evaluating student comments in class discussion consider the following items:

a. Quantity of student contribution.
b. Content of student's remarks as these indicate knowledge of topic, critical and/or innovative thinking by student
c. Relevance of student's remarks to subject under consideration.
d. Clarity of expression and presentation by student.

Based on the four considerations above, points should be awarded on a five point rating scale:

5 points-excellent
4 points-above average
3 points-average
2 points-below average
1 point-poor

Separate points should be given for each comment made by a student and recorded in the appropriate column in the sample Evaluation Sheet for Large Group Discussion below:

Evaluation Sheet for Large Group Discussion

NAME	POINTS	TOTAL
1. Sam Sunshine	4, 3, 4, 2	13
2. Mary Mushroom	1, 5, 2	8
3. Fred Frog	3, 3, 2, 1	9

TEACHER COMMENT NO. 4 : Descriptions of a City

Florida Statutes 165.02 - Distinction of Cities and Towns

Whenever any municipal government is established and it shall appear that there are 300 registered voters within the limits to be designated, it is incorporated and designated as a city, entitled to privileges of a city. All municipal governments having a less number of voters than those named above are designated and declared incorporated towns, entitled to privileges of incorporated towns.

U.S. Census Bureau - Urban Areas

According to the 1970 census definition, the urban population comprises all persons in (a) places of 2,500 inhabitants or more incorporated as cities, villages, boroughs (except Alaska), and towns (except in New England, New York, and Wisconsin), but excluding persons living in the rural portions of extended cities; (b) unincorporated places of 2,500 inhabitants or more; and (c) other territory, incorporated or unincorporated, included in urbanized areas.

United Nations - Demographic Yearbook - 1971 - p. 23

A City proper is a large locality of legally fixed boundaries and an administratively recognized urban status which is usually characterized by some form of local government.

The urban agglomeration has been defined as comprising the city proper and also the suburban fringe or thickly settled territory lying outside of, but adjacent to, the city boundaries.

TEACHER COMMENT NO. 5: Evaluation Form for Visuals

Four areas for the evaluation of visuals are suggested. Each area should be rated by the following scale: 5 points - excellent; 4 points - above average; 3 points - average; 2 points - below average; 1 point - poor. Note: Part 4, Clarity, has four sub-areas which combine to make the total value for Part 4.

Student's Name _____ Title or Topic _____

POINTS	AREA OF EVALUATION
_____	1. APPROPRIATENESS If the student has had an opportunity to select either the topic or method of his presentation, is the choice of either or both appropriate to the assignment?
_____	2. ACCURACY Are the facts used in the presentation accurate? If not, where is the inaccuracy?
_____	3. COMPLETENESS Does the presentation represent a complete statement or coverage of the subject (is there material or facts omitted which makes the presentation misleading)? If not, where is the presentation lacking?
_____	4. CLARITY Is the presentation clear to the viewer? _____ a. Is the viewer readily able to determine the point or message contained in the presentation? _____ b. Is the presentation free from unnecessary distractions? (pictures, drawings, etc. which do not contribute to the purpose? _____ c. Are the colors and sizes of lines, bars, and/or pictures suitable? _____ d. In the case of a collage or drawing, is the focal point clearly determined?
_____	COMMENTS: _____
(Total Points)	

TEACHER COMMENT NO. 6: Evaluation Form For Oral Report
(To be filled in by students and/or teacher)

Subject of Report _____ Student reporting _____

I. Knowledge of subject matter and/or what way questions were answered.

_____a. Excellent (5 points) _____b. Good (4 points) _____c. Fair (3 points)
_____d. Poor (1 point)
Points Earned _____

II. Presentation of material by using audio/visual aids. Evaluate each aid used from 0--5 points.

_____a. Charts _____b. Maps _____c. Graphs
_____d. Guest Speaker _____e. Slides _____f. Films
_____g. Filmstrips _____h. Table Display _____i. Study Guides
_____j. Puzzles/Games _____k. Skits _____l. Other
Points Earned _____

III. Equipment used in presentation. Evaluate each aid used from 0--5 points.

_____a. Opaque Projector _____b. Filmstrip Projector _____c. Overhead Projector
_____d. Film Projector _____e. Globe _____f. Chalkboard
Points Earned _____

IV. Speaker's attitude towards listeners, tone, and quality of voice should be considered. Evaluate as #1.

_____a. Excellent _____b. Good _____c. Fair
_____d. Poor
Points Earned _____

V. Evaluation of the participation of the members of the groups. (Use where applicable)

_____a. Excellent _____b. Good _____c. Fair
_____d. Poor
Points Earned _____
Total Points _____

TEACHER COMMENT NO.7: Largest Cities of the World

Exact rating of the cities of the world according to size is impossible because of the diversity of the ways in which census or estimated population figures have been issued. Therefore, the rating shown in this chart must be considered only approximate.

	City and country	Population	Year		City and country	Population	Year
1.	Tokyo, Japan	9,005,000	1969	11.	Seoul, South Korea	3,794,959	1966
2.	New York, N. Y., U.S.A.	7,895,563	1970	12.	Delhi, India	3,722,451	1970
3.	London (Greater), England	7,703,400	1969	13.	Buenos Aires, Argentina	3,600,000	1970
4.	Moscow, U.S.S.R.	6,942,000	1970	14.	Leningrad, U.S.S.R.	3,513,000	1970
5.	Shanghai, China	6,900,000	1957	15.	Chicago, Ill, U.S.A.	3,366,957	1970
6.	Bombay, India	5,700,358	1970	16.	Tientsin, China	3,220,000	1957
7.	Sao Paulo, Brazil	5,684,706	1968	17.	Berlin, Germany	3,214,766	1971
8.	Cairo, Egypt	4,961,000	1970	18.	Calcutta, India	3,158,838	1970
9.	Rio de Janeiro, Brazil	4,207,322	1968	19.	Mexico City, Mexico	3,025,564	1970
10.	Peking, China	4,010,000	1957	20.	Osaka, Japan	3,018,000	1969

1973 Information Please Almanac, Atlas, and Yearbook, p. 310.

TEACHER COMMENT NO. 8: Air Polution: Causes, Costs and Controls

Anyone who has taken a good deep breath of city air recently will readily attest to the fact that air pollution is a serious problem in this country today. Although it may be simple to observe air pollution, it is neither simple to understand the problem, nor to solve it. This article provides a survey of the major sources of air pollution, its effects -- physicals, psychological and economic -- and possible solutions.

Air is free. Economists have long explained this on the basis of the fact that there is more of it available than could possibly be sold at any finite price. Nowadays, however, the classic economic argument may not hold water (air?). As a matter of fact, if someone could guarantee a perpetual pocket of clean air around urban or suburban dwellings. there would probably be a good many buyers. Of course, air is NOT a commodity which can be thus marketed, but air pollution might conceivably be less of a problem if air could be treated in this manner. Hypothetically, then, individuals would be charged an appropriate price for breathing, presumably based on their lung capacity and respiration rate, and possibly be assessed fines for returning the air to the atmosphere laden with cigarette smoke. More importantly, a party wishing to use the air as a medium for dispersal and disposal of gaseous wastes (e. g. , an industrial plant) would have to pay for the privilege of so doing, with the amount of payment varying with the degree of contamination. While the idea of individuals placing coins in vending machines to obtain a whiff of clean air is inherently absurd, the concept of requiring industries to pay for reducing the usefulness of the atmosphere for other purposes (such as breathing) has considerable promise as a preventative measure. This will be discussed in further detail later.

The Atmosphere: An Unlimited Ocean?

Not too long ago, the atmosphere was generally conceived to be a vast, virtually inexhaustible reservoir of air, just as the oceans are reservoirs of water. Today, however, a mere sophisticated ecological concept of the atmosphere is emerging. Unlike water, which is removed from the ocean as vapor and returned again as rain or runoff from the continents but never changes its basic chemical form, the life-sustaining oxygen in the atmosphere is a highly reactive substance which combines with many other elements to form new compounds known as oxides. By far the most of common of the oxides is carbon dioxide (CO_2), which is formed in nature by the metabolic processes

of animals, released into the atmosphere and then used by green plants to manufacture food through photosynthesis. During the photosynthetic reaction, oxygen is released into the atmosphere. As a result, an atmospheric equilibrium between oxygen and carbon dioxide is maintained. Until man enters the picture, that is. Civilization has disrupted the oxygen-carbon-dioxide cycle in many ways. Probably the most significant is the combustion of fossil fuels such as coal, petroleum and natural gas, which consume oxygen and release extra amounts of carbon dioxide at a prodigious rate. In the United States in 1965 some 1.3 billion tons of fossil fuels were consumed for all purposes, combining with 2.74 billion tons of atmospheric oxygen to produce 3.77 billion tons of carbon dioxide, not to mention enormous tonnages of other by-products, most of them unwelcome. It has been estimated that in North America the consumption of atmospheric oxygen in the process of burning fuels is about 10 times greater than the total consumption of oxygen by all human beings and animals on the continent, and the corresponding production of carbon dioxide is approximately 7.5 times as great. There are other man-caused factors which deplete the atmosphere of oxygen. Erosion, deforestation and defoliation of large stretches of country-side reduce the number of green plants which add oxygen to the air. The same effect is achieved by plowing grasslands for crops, because the land is left bare for part of the year; and by the continual paving of what was once grasslands or forests. There is evidence that water pollution can reduce the production of oxygen-generating phytoplankton (algae) in coastal waters. On the other hand, fertilization of surface waters by organic wastes may increase algae growth. It is also possible that increased levels of carbon dioxide in the atmosphere actually stimulate photosynthesis and thus tend to be self-regulating. Although the ecology of the atmosphere is too young a science to have established hard-and-fast principles it has determined that "...the atmosphere is clearly a finite and extremely valuable resource which is probably being used up or degraded considerably faster than it is being regenerated. It is hardly the unlimited reservoir it was generally imaged to be as recently as a decade or two ago."

Since the atmosphere must be regarded as finite, rather than infinite, it follows that different uses of it may not be compatible. And since the use of the atmosphere is not controlled by a competitive market but is available to all in unlimited quantities and at no charge, it is becoming increasingly apparent that the primary use of this resource -- to support animal life -- is being jeopardized by secondary interests such as industry and transportation, which use it as a sink for the by-products of combustion. The conflicting demands we place on our atmosphere are begining to

exceed its capabilities to satisfy all needs. As a result, we may soon be faced with some very basic choices.

Fossil Fuels Cause Pollution

Before we can make good decisions, however, we must be fully informed about the causes and effects of the problem. The most important source of air pollution is energy conversion, especially in the combustion of fossil fuels. The four major fuel consumers are the electrical utilities, transportation, industry and households and commercial establishments. The major primary fuels utilized are coal, petroleum and natural gas; electrical energy becomes the major secondary fuel for the other users. The table below summarizes the fuel requirements of each of the major consumers.

Sources of Energy Used by Various Sectors (1966)
(in percents)

	Utility	Trans-portation	Industry	Households and Commercial
Coal	55		29.4	0.4
Petroleum	6	99.85	22.8	38.8
Natural gas	22		39.3	42.8
Utility electricity	a	0.15	8.5	14.4
Other	17			3.6
	100	100.00	100.0	100.0

[a] Not applicable.

As the chart shows, all three major fossil fuels are used in the production of electrical power. Nuclear and hydroelectric installations comprise the majority of the "OTHER" category. The key factor in determining which fuel is used in a given location is the cost per British Thermal Unit (BTU). Natural gas is dominant in the west and southwest near the major gas wells. Water power is used in the northwest where it is abundant. Residual oil imported from Venezuela is used in many power plants along the Gulf and Southeast coasts. Coal is the primary fuel source in the midwest and east, and is used to some extent in other areas as well.

As of 1966, more than half our electric power came from the burning of coal. Water power is advantageous in that it does not cause pollution, but the ecological consequences of installing dams can be far-reaching. Natural gas is comparatively clean, producing few unwanted emissions other than carbon dioxide, but it is relatively expensive in the populated Northeastern and Middle Atlantic states which are far removed from the primary sources. Nuclear power does not normally cause much air pollution, but it is a major cause of thermal pollution to waterways, and is also a potential source of contamination from radiation. Residual oil is relatively inexpensive near the source, but supplies are dwindling. Coal is fairly abundant and cheap, but it is often obtained through strip-mining, which wreaks havoc with the environment. A major problem associated with the utilization of both coal and petroleum by the utility industry is the fact that these fuels normally contain a considerable amount of sulfur (about 2.5%) as an impurity. During combustion, sulfur is converted to sulfur dioxide (SO_2) and sulfur trioxide (SO_3), two of the most dangerous air pollutants. The sulfur oxides are in themselves toxic substances, and they combine with water to form sulfurous and sulfuric acid (H_2SO_3 and H_2SO_4, respectively). These acids are highly irritating to the lungs and bronchial passages, and are also destructive to plants, painted surfaces, bare metal and stone. Electric utilities produced approximately 13.6 million tons of sulfur oxides in 1965. They also generated an estimated 3.7 million tons of nitrogen oxides, 2.5 million tons of carbon monoxide (CO), and 2.4 million tons of particulates (soot).

Go Now, Pay Later

A quick glance at the chart tells you what you already know about transportation -- most of it depends on petroleum products. This is because of the ease of storage and handling of liquid fuels. Sulfur dioxide is not a major problem in

the emissions of motor vehicles, however, because 90% of the fuel used is gasoline (for automobiles and small trucks), and the rest is jet fuel (similar to kerosene) and diesel oil (for large trucks). All these fuels are distillates, produced in refinery processes which eliminate such impurities as sulfur. A new substance is often added, however -- tetraethyl lead. The purpose of deliberately blending this substance with gasoline is to reduce engine knocking by increasing the "octane number." Although the quantity per gallon is extremely small, on a national basis this amounts to 200,000 tons of lead per year (one-sixth the nation's lead production), nearly all of which ends up as very fine particles in automotive exhaust which is dispersed into the air. Full studies of the ecological effects of such emissions upon plants and animals have not yet been developed, but it must be accumulating somewhere. An even more important problem associated with the internal combustion engine, however, is incomplete combustion. As much as 10% of the fuel is wasted and dissipated into the atmosphere either unburned or partially burned. The most serious effect of incomplete combustion is the production of enormous quantities of carbon monoxide. An estimated 10 million tons of this deadly gas were released into the atmosphere over the United States in 1965. If it were not for the dispersing effects of winds and the eventual oxidation of carbon monoxide into non-toxic carbon dioxide, the concentration of carbon monoxide in traffic-filled cities would rapidly pass the lethal level of 200 parts per million (ppm), or 0.02%. Even now, peak concentrations of up to 140 ppm have been observed over city streets during periods of heavy traffic . . . obviously too close for comfort. Moreover, levels of only 40 ppm are thought to be enough to impair both physical and mental functions. If this is true, it is conceivable that carbon monoxide could be a contributing cause of many automobile accidents incities and on crowded turnpikes. Carbon monoxide is not the only contaminant released into the atmosphere by motor vehicles. Oxides of nitrogen (nitrogen oxide and nitrogen dioxide) are also produced by the high-temperature, high-pressure combustion processes characteristic of the internal combustion engin. Some 5.7 million tons were released in 1965. Nitrogen oxides are themselves toxic and, together with unburned hydrocarbons, are the main ingredients in the photochemical mixture which constitutes Los Angeles-type "smog." Automobiles are a significant source not only of gaseous emissions, but particulates. There are minor amounts of these substances in the exhaust, others come from mechanical wear, especially from the rubber on tires and the asbestes of brake linings. One major cause of the traffic jams which contribute to urban air

pollution problems is the inadequacy of mass transit systems in most cities. Only in New York City is a significant fraction of total passenger-miles attributed to railroads or rapid transit. Although people living in densely populated areas travel somewhat less by automobile than people living in suburbs or smaller towns, the differences are not great on a national basis. In fact, since automobile trips of over 100 miles are estimated to account for only 20% of total automobile passenger-miles, the majority of the shorter trips can be assumed to take place where the majority of people live -- in and near cities. Air pollution is the consequence.

Industries Tie Up Clean Coals

The other major users of fossil fuels, besides motor vehicles and the utilities, are industries and households. All three major types of fossil fuels are utilized in industrial processes, especially metallurgy, cement and glass manufacture and refactories. Some 188 million tons of coal were used by industry in 1965, of which more than half (96 million tons) was first carbonized to produce 77 million tons of coke, plus coal gas, coal tar and coal tar derivatives. Since low-sulfur sources of Pennsylvania and West Virginia are tied up in long-term contracts, which limits their availability to the electric utilities. As a result, industry produces less sulfur dioxide than the utilities. Coal is no longer used to any appreciable extent for space heating purposes, but both natural gas and petroleum are. According to statistics compiled in 1965, industrial and space-heating sources were the leading "suppliers" of the nitrogen oxides and particulate matter emitted into the atmosphere, producing an estimated 7 million tons of each. They also generated a total of 8.4 million tons of sulfur dioxide, less than the utilities, but still a significant amount.

Another cause of urban air pollution is waste -- during production, during processing, during consumption and after consumption. The first category refers to the escape of some portion of fossil fuels, especially natural gas, by evaporation during production, or the release of noxious fumes into the atmosphere by evaporation during various types of industrial production. The second includes evaporation losses of chemical and petroleum derivatives during refining, transporting and delivery. The third category refers to a number of "intermediate" products which are not actually part of the product being consumed, but which are released into the environment during normal usage. Included in this category of air pollutants such as cleaners, solvents, pesticides, explosives and aerosol propellants. The fourth category is comprised of gaseous and particulate pollutants resulting from the incineration

of solid wastes.

Fortunately, some of the most dangerous airborne industrial wastes such as the fluorides (which are a by-product of the production of fertilizer), the sulfur oxides (which are associated with copper, zinc and lead production) and the unpleasant and often toxic fumes from oil refineries are usually not produced in urban areas, although anyone who has visited northern New Jersey will attest to the fact that there ARE some major refineries adjacent to metropolitian areas. And chemical plants, among the most prolific producers of vile-smelling, corrosive and irritating fumes (especially the mercaptans such as hydrogen sulfide) ARE usually located in or near cities. The DuPont complexes at Wilmington, Del., are a good example.

Spray Now, Pay Later

Although solvents are not generally considered when the problem of air pollution is discussed, they are significant contaminants to the environment. This category includes turpentine, benzene, xylene, naphtha, methyl, ethyl, and isopropyl alcohols; glycol ethers, acetone, methyl-ethyl-ketone, carbon disulfide, carbon tetrachloride, vinyl chloride and various other chlorinated hydrocarbons. Not all the above are used exclusively in ways which contribute to air pollution, but large quantities of dry-cleaning agents, paint removers, paint thinners, varnishes and lacquers are dissipated into the atmosphere. The function of solvents is either to remove solids from places where they are not wanted or facilitate their application in places where they are wanted. Its function fulfilled, the solvent is often allowed to escape (through evaporation). Even if it is recycled, as in commercial dry-cleaning plants, there are bound to be some losses each time, all of which help contaminate the air we breathe.

The disposal of waste products after consumption of goods is a major problem in urban areas. Americans produce approximately four pounds of garbage, trash and junk apiece every day, for a national total of 150 million tons a year. Since about 80% of these waste products are combustible, they are often incinerated at their point of origin, or a central site nearby, to reduce refuse collection costs. However, uncontrolled burning at local points releases tremendous quantities of smoke, soot and ash into the atmosphere. For this reason, many large cities have installed enclosed furnaces in which to dispose of the bulk of their solid wastes, but even so a significant fraction of the fly ash, and 100% of the sulfur oxides and nitrogen oxides escape into the atmosphere. Several million tons of soot are released into the air over American cities each year by the burning of solid wastes alone.

"In New York City about 75 tons of particulates a day are attributed to municipal refuse burning and a further 61 tons a day are attributed to dwellings and apartment houses -- of which a significant fraction is also due to incineration. All in all, probably half of all particulates (soot) come from this source."[2]

Air Pollution Attacks on Many Fronts

It is obvious, then, that inhabitants of most American cities today are bombarded with a wide variety of air pollutants from many different sources. The next logical question is, WHAT DO THESE POLLUTANTS DO? The effects of air pollution may be divided into four major categories: on people, on plants and animals, on property, and on weather and climate. Of gravest immediate concern, of course, are the effects on human health. It is not usually possible to trace fatalities directly to air pollution, because the effects of pollutants are generally synergistic; that is, they interact with other influences such as existing respiratory diseases and cigarette smoking. Air pollution is one of several environmental stresses which tend to increase the incidence and seriousness of a variety of respiratory diseases, such as lung cancer, emphysema, tuberculosis, pneumonia, bronchitis, asthma and even the common cold. Studies have linked most or all of these with prolonged exposure to polluted air. The potentially lethal effects of air pollution were dramatically revealed by a sharp increase in death rates (mostly among the elderly or those already suffering from a respiratory ailment) during air pollution crises in the Meuse Valley, Belgium, in 1930 (60 deaths); Donora, Pa., in 1948 (20 deaths); London, 1952 (3500-4000 deaths), and New York City, in 1965 (400 deaths). For every death associated with air pollution, there are many persons who have become ill to the point of requiring medical treatment, and countless others who suffer significant annoyance in the form of lesser symptoms such as coughing, wheezing, chest pains, and irritated eyes, without seeking medical treatment. Finally, there are those who suffer psychological reactions to soot, bad smells and other unpleasant environmental aspects of pollution. This group includes nearly everyone living in an urban area. Although they are obviously not as serious as fatal diseases, minor discomforts and aesthetic objections of air pollution are becoming increasingly important facets of the air problem. This is due primarily to two factors--the rising level of education in the population at large, which has produced a much keener general awareness of the pollution problem; and the growing prosperity of many classes of people, which increases demand for "superior goods" such as color televisions, green grass, large automobiles and clean air. (This suggests a corruption here of the age-old cliché; viz., "You can't

burn your air and breathe it too.") In any event, where belching smokestacks were once welcomed as a symbol of a booming economy and full employment, they are much more likely today to be taken as indicators of obsolescence and irresponsibility.

Animals and Plants Breathe Too

Man is not the only living creature affected by air pollution. Animals are also subject to the ravages of filthy air. Fortunately, most livestock is raised in rural areas, well removed from the air pollution of cities, but there have been cases of fluoride poisoning from the ingestion of plants which have accumulated fluorides from fertilizer plants located in rural areas. Within cities, air pollution affects pets, but because such effects are usually chronic (gradual) rather than acute (immediate and usually severe) they tend to go unnoticed. Nevertheless, it is probable that air pollution causes considerable discomfort for dogs, cats, birds and other household pets, and it may shorten their lives.

As far as plants are concerned, most crops are removed from the cities and not greatly affected by air pollution, except fluorides from fertilizer plants and sulfur oxides from copper smelters. However, there are some districts where truck crops, mostly fruits and vegetables, are grown near major cities -- particularly in Connecticut, Long Island, New Jersey, eastern Pennsylvania, Delaware and southern California. Agricultural damage in the citrus belt of southern California is caused primarily by oxidants such as ozone and peroxy-acylnitrate produced by the interaction of unburned hydrocarbons, nitrogen oxides and strong sunlight. In the Middle Atlantic states, vegetables are spotted and discolored by sulfur oxides. Stunted growth may also result. Harmful effects have also been detected on shrubs, flowers and shade trees in suburban gardens and city parks.

Effects of Air Pollution are Hard to Isolate

Just as it is difficult to trace the specific effects of air pollutants on human health, it is difficult to link a given symptom of plant disease to a particular pollutant. Air pollution is one significant environmental stress upon plants; others are drought, extreme cold or heat, and pests. Mostly healthy plants can withstand moderate exposures to any one of these stresses, but not two or three simultaneously. In this sense, air pollution may be "the straw that breaks the camel's back," in that it is an almost constant stress, and the other environmental hazards occur periodic-

ally.

Air pollution affects property as well as living things. Here, again, the sulfur oxides and the oxidants are the most damaging pollutants. Both ozone and the sulfur oxides can harden and weaken rubber, plastic, paper and other materials. In addition, sulfuric acid formed by the combination of SO_3 with water is a particularly corrosive acid which can damage virtually any exposed metal surface, as well as limestone or marble. Probably the most noticeable form of property damage is from soot, which darkens clothing, painted surfaces, furniture, carpets, drapes, automobiles and buildings. Soot causes higher bills for laundering, dry-cleaning, painting and maintenance, and even with upkeep, dirty air makes for drab, gray environment.

The fourth major effect of air pollution is meteorological. Air pollution definitely affects weather in cities. Temperatures and humidity are higher, precipitation and cloud cover slightly greater, and fog is much more common, especially in winter, than in surrounding regions. The two major causes for these phenomena are probably the waste heat generated in cities and the high concentrations of particulates, which serve as condensation nuclei for fog or possibly even seed the clouds to produce rain. Other pollutants may be involved as well.

Will We Drown Our Seacoasts?

Scientists have expressed fear concerning much broader climatological responses to air pollution. Some have suggested that the massive build-up of carbon dioxide over wide reaches of the earth might trap solar energy in a "greenhouse effect" which would eventually melt the polar icecaps. One obvious consequence would be a gradual rise in sea level which would threaten coastal cities. On the other hand, it has also been suggested that the higher temperatures could trigger a new ice age as a reaction. This would cause the exact opposite effect; many seaports would be left high and dry as the oceans receded.

How do you measure the costs of air pollution? The usual approach has been to add up dollar expenditures, such as extra cleaning or hospital bills, which would not have been necessary if there was no pollution, add the losses in future income due to death or disability related to air pollution, and call this its cost. This model oversimplifies and distorts the situation. It has several weaknesses. For one thing, hospital and burial costs, plus lost future income, can hardly be considered a good estimate of the value of human life. Also, since life, health and clean, fresh air are normally FREE, there is no way to compute a dollar loss if these benefits are removed.

but is it valid to assume statistically that the loss is zero?

It is apparent, therefore, that there are some costs of air pollution which are inherently impossible to measure, because they cannot be reduced to quantitative terms. In this sense, current approximations of the cost of pollution may be understatements. On the other hand, there are economic factors which complicate the situation. Consider, for example, the case of the payment of extra dry-cleaning bills due to soot in cities. If the soot were eliminated, the people wearing the clothes would save money, but the laundry would lose money. Although most people suffer losses from air pollution, the benefits of some others, such as the laundry, would have to be subtracted from the losses to derive an accurate estimate of the cost of air pollution.

Air Pollution Has Economic Benefits for Some

The same reasoning applies on a national scale. It is quite possible that expensive problems caused by pollution, such as extra laundry, cleaning, maintenance and painting, help provide jobs for unskilled and semi-skilled laborers who might otherwise be unemployed. Again, to arrive at an accurate estimate of pollution costs, the expenditures to repair damages would have to be reduced by the dollar benefits in terms of employment.

There is an even more basic economic problem connected with the determination of air pollution costs. Although air pollution causes millions of dollars in damages, it would also cost a great deal to correct it. The fact that pollutants can be disposed of into the environment at little or no cost to the polluter means that some goods and services are probably being sold more cheaply than they would if the usage of air was regulated. Electric power is a case in point. Power would be more expensive if the utilities had to pay the economic price of passing their wastes on to others in the form of air pollution. Since electric power is basic to all other industries, production of many other items would also become more expensive, raising their prices as well. All these price increases would have to be subtracted from the cost of the damages presently caused by air pollution to come up with a good estimate of the cost of pollution.

Computing the Cost of Air Pollution

To summarize, the cost of air pollution would be equal to the sum of all property damage, medical expenses and approximate economic costs of deaths and disabilities caused by air pollution (however imperfect the approximations are), MINUS the economic benefits of pollution in terms of profits for certain concerns (such as the laundry), employ-

ent benefits, and potential price increases which would be caused by the reduction of air pollution. Ironically, if this formula were worked out, it might well turn out that economically, at least, "air pollution is good for you." To explain this paradox, we need only return to the concept of free benefits -- health, life and clean air. Although it is extremely difficult to place a price tag on these, most would agree that the cost of sacrificing these amenities of life would greatly exceed the possible benefits of an economy which pollutes.

One marketplace in which the economic effects of air pollution are quite clearly evidenced is the real estate market. It reflects mostly the tangible, immediate, noticeable effects of air pollution, such as the deterioration and extra cleaning and maintenance costs; the milder medical symptoms such as shortness of breath and smarting eyes, and aesthetic considerations such as bad smells and dirt. In one experiment in St. Louis, eight different "sulfation zones" were identified according to the concentration of sulfur dioxide in the atmosphere. Average property values for the eight areas were compared. It was found that the average property values varied $250 per lot, per zone, other things remaining equal. In other words, the identical house would cost $2000 more at the highest sulfation level than at the lowest. As people become more aware of the more serious long-term consequences of air pollution, such as lung cancer and emphysema, the difference in property values is apt to increase. Just how much value is attached to human life remains a question mark. Whatever this value is assumed to be, it must certainly be considered the most important cost of air pollution.

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The Key Question: How to Stop It?

How can we control air pollution? This question is really divided into two major categories, policy and technology -- policy referring to the general plan, technology to the specific scientific means of prevention. Concerning policy, there is a wide range of possibilities, depending largely on the attitude of the policy-maker toward the free market. A "free market" approach operates on the premise that most costs arising from air pollution are the result of market failures, and therefore seeks to correct these failures by certain adjustments WITHIN the free market. The alternate strategy is known as an ad hoc response -- a pragmatic reaction designed to deal with specific air pollution problems as they arise. The latter policy often involves the imposition of controls (or incentives) from OUTSIDE the free market by the government. There are strengths and weaknesses to each model. One technique used in the market-preserving approach attempts to eliminate external forces by "internalizing" them. On a governmental level this leads to regional

agreements and the formation of "super-agencies" to set regional air pollution standards, rather than have them imposed from outside. In private business, internalization would be achieved through merger. In the extreme application, all producers and consumers would be merged into one unit, resulting in public ownership of all pollution sources. However, this technique is not viable[1] because it would eliminate competition, a basic feature of the free market.

A second method of attacking air pollution within the mechanism of the free market would be by attaching prices to all services -- and disservices -- which are now provided "free" by the atmosphere. In theory, charges would be made for all uses of air. Charges for breathing would be small, since ample air is available for this process. Charges for oxygen used for combustion would be the same PER UNIT as breathing charges, but the total would be much greater due to the quantity of oxygen consumed. Surcharges would be imposed upon individuals or corporations using the atmosphere as a recepticle for by-products or inefficient combustion or other chemical processes. On the other hand, persons receiving undesirable inputs from the atmosphere, such as smog or soot, would receive compensation. It is intuitively clear that this sort of plan will not work. The economic reason for this is that it is impossible to attach finite prices to a commodity so long as it is held in common as a public good.

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Effluent Taxes Could Be Effective

There ARE ways to modify the idea, however, which may be very effective. One is the concept of an "effluent tax," which would require a producer of pollutants to pay the government (as a surrogate[2] of the public) a penalty in direct proportion of the quantity of contaminants dispersed into the environment. It would then be up to the producer to decide how much pollution he could afford; the only control would be economic, rather than legal. This method has the advantage of exploiting the machinery of the free market rather than inhibiting it. For example, consider again the electric power industry. Its major products are (1) electricity, and (2) soot (disregarding other effluents for the moment). It buys the cheapest possible fuel, sells electricity and "gives away" its soot and other effluents. Suppose the industry is required to pay for polluting the environment. It can then take one of

[1] viable-workable, useable

[2] surrogate-substitute, representative

two courses of action -- simply pay the penalty and pass the cost on to the consumer in the form of higher prices, or shift to cleaner fuel, install precipitators on its smokestacks and reduce the output of soot. This too would cost money and cause higher prices. Since demand for power would be expected to decrease as prices increase, it is in the interest of the power compaines to keep rates down. They would therefore by more likely to seek controls, which would become less and less expensive as people followed an incentive to develop improved methods, rather than simply pay fixed penalties indefinitely. The government could accelerate this process by stepping up the penalties each year.

The Ad Hoc Method

The ad hoc approach to controlling air pollution is more specific and direct. Its major techniques are legal enforcement of arbitrary standards and the use of subsidies or tax credits as external incentives to industries to comply with standards. Arbitrary standards amount to a simple statement that emissions from a particular industrial process or engine shall not exceed a given amount, along with a means of enforcement.

Theoretically, this method might result in standards being set unrealistically low, or even at "zero," but in actuality the determination of such standards has often been unduly influenced by political lobbies of the large industries affected, and the standards have often been too lenient. Another problem associated with this technique is enforcement; it is often very difficult to establish reliable means of monitering the discharge of effluents. (This problem would also be critical in the administration of an "effluent tax" technique, since the amount of payment would vary directly with the exact amounts of effluent.)

Industry prefers the use of government subsidies or tax credits as incentives to install pollution control equipment. One problem associated with this method is that it is often possible to land a sizable windfall profit by overestimating the cost of control equipment, or attributing to pollution control major capital investments the firm had intended to implement anyway. It would require highly trained and perceptive government officials to detect such frauds.

Some Industries Could Not Afford to Clean Up

Another problem connected with any form of emissions control or effluent taxes is the case of a few industries which might legitimately be discriminated against. Although it seems unfair to make exceptions for certain industries, the

government would be faced with a knotty problem regarding industries which could simply not afford to assume the costs of converting to cleaner, more efficient processes and still remain competitive. A case in point would be the leather industry, which could probably not clean up and still compete with synthetics. (One way to deal with this problem would be to require meat-packers to share part of the costs, since without the leather industry, hides would become a major disposal problem for them, but this would probably raise the price of meat.) Other industries based on natural products (sugar refining, paper mills, etc.) might face similar economic problems. In these situations it would probably be necessary to provide for a public buy-out or a temporary subsidy to ease the period of transition to cleaner production.

No matter what policies are developed to cope with air pollution, they will not be effective unless adequate technological controls are available. There are two basic approaches to the control of air pollution -- symptomatic treatment and process change. The first method does not attempt to keep pollutants from being produced; it merely seeks to prevent their dispersal into the environment. Thus smoke precipitators, stack gas absorbers, filters and washers, afterburners and catalytic mufflers for automobiles are all symptomatic treatment devices. There are advantages to such techniques. In the case of automobile exhausts, for example, the chief problem, especially with carbon monoxide, arises from incomplete combustion. An afterburner would therefore provide a very useful service. In some cases, collection devices could actually furnish a saleable by-product. Fly ash precipitated from smoke stacks, for example, could be converted into insulation or filler and marketed quite effectively. On other occasions, however, symptomatic treatment merely substitutes one form of pollution for another. Thus sulfur dioxide can be removed from gaseous wastes by "washing," but what is to be done with the sulfur-laden water?

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Cure the Disease, Not Just the Symptom

In the long run, the process-change technique is more promising, although it may be costly during the conversion itself. There are several examples of potential process changes which could reduce air pollution. Electric utilities could shift from high-sulfur to low-sulfur oil, or use either natural gas or gassified desulfurized coal. Power plants could be built closer to coal mines, thus reducing both transportation costs and cutting down on the heat and pollution released in urban airsheds. A shift to nuclear power will also reduce air pollution, although the problems of thermal

pollution and radioactive wastes will need to be surmounted. Ultimately, however, the use of controlled thermonuclear reactions (fusion) will probably eliminate all these problems.

Another area where basic process changes could exert a profound influence on air pollution is transportation. Research has already indicated that an external combustion engine (ECE) could be developed using steam or a synthetic working fluid such as freon, which would duplicate or surpass the characteristics of the traditional internal combustion engines in terms of power, weight, effective range, smoothness of operation and fuel consumption efficiency, with much fewer emissions. In fact, evidence suggests that the external combustion engine could be simpler, cheaper to manufacture, longer-lived and more economical to operate than the internal combustion engin. An alternative switch would be used instead of gasoline. These vehicles would also cause much less pollution, but they would probably be too expensive for the average person to purchase. (This problem, however, could probably be circumvented[3] by means of a marketing technique which took advantage of the extremely low operating costs of such a vehicle in order to offset the high original cost. For example, electric-powered cars might be rented and recharged periodically at approximate the cost of gasoline and upkeep for internal combustion engine cars.)

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Industry Would Resist New Types of Motor Vehicles

Either the external combustion engine or battery/fuel cell vehicles would greatly reduce the levels of air pollution, especially in urban areas, but it would be extremely difficult to initiate such a major process change in an industry as massive and entrenched as the automobile industry (General Motors is the world's largest corporation), not to mention the large petroleum corporations. Probably the best course to follow in this area would not be direct governmental controls, but indirect incentives. An example would be the enormous amount of money invested by the Atomic Energy Commission in the 1950's to research and develop the possibility of nuclear power; with no direct government intervention, the utility industry has begun to move in this direction for economic reasons. The government could also apply pressure by taxing an "indesirable" activity. Increasing registration charges for inefficient internal combustion engines in direct proportion to the amount of emissions would be an example of such a negative incentive. (One unwelcome offshoot of this technique, however, is that it might perpetrate a social injustice by hitting hardest at the people who could least afford it.) The government could also use positive incentives, such as waiving registration charges for

[3] circumvented-avoided

newer, cleaner vehicles, or even deliberately creating a market for improved products with its own purchases. An example of the latter strategy would ge specifying that all new Post Office, police and other governmental vehicles be steam or electric-powered. Although this method has not yet been tested, it is likely that free market competition would result in fairly rapid development of the new products in order to capitalize on the large government contracts. At first the cost to the public would be greater, thereby elevating taxes, but competitive bidding would probably drive the costs down as time wore on.

--Ayres, Robert U., "Air Pollution in Cities," Politics and Environment, ed. Walt Anderson, Goodyear Publishing Co., Inc., Pacific Palisades, California, 1970, pp. 78 - 100.

TEACHER COMMENT NO. 9: Air Pollution and Plant Life

One sure sign of air pollution is wilted and speckled vegetation. So sensitive are some plants to air pollution, in fact, that many industries now use the ornamental greenery on their premises as a kind of "Early Warning System" for air contaminants. In many cases, it is possible to determine just from examination of certain plants both the types of air pollutants present and the concentrations of these substances. Not very often is vegetation so expendable, however. Many farmers located near sources of air pollution have given up in despair and sold out to real estate developers. "Now children, instead of spinach, take their chances with the poisonous air."

Four air pollutants which are extremely destructive to vegetation are sulfur dioxide, fluorides, photochemical smog and ethylene. Until the recent development of new and specialized industries which produced a wide range of new pollutants, most serious foliage destruction resulted from sulfur dioxide. In the early 1900's copper smelters in places such as Anaconda, Montana and Ducktown, Tenn., emitted sulfur dioxide fumes which drifted for miles and left in their wake a gullied wasteland. Controls have since cut down somewhat upon these effects, but hugh amounts of the gas are still released into the atmosphere as a by-produce of the smelting of copper, iron, zinc and other ores, because the major energy source for the smelting process is still the combustion of fossil fuels which contain sulfur as in impurity. Coal and oil-burning power plants also contribute sulfur dioxide to the atmosphere.

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Plants Inhale A Deadly Vapor

Sulfur dioxide enters a growing plant through the stomata, or tiny openings, on the underside of the leaf, as does carbon dioxide. The injury usually shows up as sried and bleached markings along the edges or between the veins of the leaf. Plants can detoxify moderate amounts of sulfur dioxide relatively quickly by chemical reactions within their leaves, and if exposure is low and brief, complete recovery of growth can follow. A prolonged period of sublethal dosages, on the other hand, can produce chronically injured areas which never recover. As the concentration of the gas increases, the plant cells die, the tissues between

the veins collapse, and the leaf becomes more and more scarred. Plants with thin leaves, such as alfalfa, barley, cotton and grapes, suffer most from sulfur dioxide because of their fast absorption rates. Plants with fleshy leaves, such as citrus and pine, tend to be more resistant except when the leaves are newly formed. Another sulfur compound which can harm plants in sulfuric acid, which forms from the combination of sulfur trioxide (an oxidized form of sulfur dioxide) with water and is often carried in the atmosphere as an aerosol which pockmarks the upper surface of leaves. Curiously, in low quantities, sulfur dioxide can actually PROTECT plants, by neutralizing the effects of oxidants such as ozone.

Flourides are another deadly enemy of vegetation. Emitted from aluminum, ceramic, chemical and fertilizer industries as well as glass-works, smelters and steel mills, these compounds also enter the leaf through the stomata. From there they move to the edges and tip of the leaf. The center of the leaf remains relatively unaffected, while lethal amounts of the chemical builds up along the edges. As exposure continues, the killing moves inward. Leaves exposed to fluorides usually have burned, dried out edges with a thin reddish-brown line of newly-destroyed tissue marking the edge of the healthy part of the plant. Even though most farming soils contain considerable amounts of fluorides, plants only take up minute quantities needed in their manufacture of food. Therefore when they contain higher quantities of fluorides than a few parts per million, air pollution can be assumed as the source. Gladiolus, prune, apricot and peach plants are especially sensitive to fluorides and are injured by extremely low concentrations. Other plants which are slightly less sensitive but still susceptible to damage are sweet potatoes, corn and conifers (cone-bearing trees or shrubs). Another fluorine compound which injures vegetation is hydrofluoric acid. Even in very small quantities, this substance can spot corn leaves and turn gladioli tips white or yellow.

Would You Believe Plastic Trees?

Smog is a relative newcomer to the pollution scene, but its impact upon vegetation has been profound. Some highways in Los Angeles feature artificial plants along the median, because growing real plants proved to be a lost cause! Smog causes the stomata to close, which prevents plants from gathering life-giving carbon dioxide for their photosynthetic manufacture of food. Through the natural food chain, all animal life, including

man, ultimately depends on the productive capacities of the green plants to sustain life. Even when concentrations of smog are not high enough to cause irreversible damage, chronic exposure appears to inhibit the growth of many plant species. Two specific injury patterns have been identified in the action of smog upon plants -- one caused by ozone, the other by PAN(peroxyacyl or peroxyacetyl nitrate). Ozone attacks the upper surface of the leaf, causing spots, splotches and streaks. In sufficient concentrations, it can cause plant tissues to collapse completely. It also leaves scars on cereals and vegetables. PAN attacks from the other direction -- on the underside of the leaf, turning it silver or bronze. Citrus trees are particularly susceptible. Ozone appears to be the primary offender in smog damage in the eastern United States, whereas PAN seems to be the most damaging substance in Southern California smog. The difference may be the greater humidity in the East, or it could be due to ozone's special destructiveness to tobacco, a major crop in the Southeast.

Ethylene is a gaseous hydrocarbon of the elefin series. It is found in automobile exhaust and as a by-product of certain chemical processes. Ethylene plays a role in the photochemical smog process, but it is destructive in its own right as well. In concentrations of only a few parts per BILLION, ethylene causes orchid sepals (the green leaves surrounding the blossom) to wither. It also impedes the opening of carnation blossoms and causes snapdragon flowers to drop off. More significantly, at just slightly higher concentrations it retards the growth of tomatoes, a truck farm crop which is often grown near urban centers.

There has been research into vegetation damage resulting from air pollution, and most of it has led to discouraging conclusions. For example, in one study tobacco plants were placed in 14 different locations in New Jersey, and the plants sustained ozone injury at every site! Other surveys indicate that specific pollutants are capable of harming vegetation a hundred miles from their point of origin. More extensive studies are required to determine exactly how air pollution affects the growth, yield, nutritional quality and even survival of the crops upon which we depend for our food and enjoyment.

Air Pollution Primer, National Tuberculosis and Respiratory Disease Association, "Pollution's Other Effects," pp. 77-87.

TEACHER COMMENT NO. 10: Atmospheric Conditions Which Cause Pollution

Pollution occurs when the air cannot absorb and spread out the particles being poured into the atmosphere. Serious air pollution is rarely caused by only one type of particle. (It) occurs when mixtures or combinations of many pollutants are added to the air.

There are two major types of atmospheric conditions which can cause pollution emergencies. They are known as "London-type" and "Los Angeles-type" pollution. London-type air pollution occurs on cold, foggy days or long winter nights with temperatures below 50^{o}, when a thick layer of dense fog forms over a city. Since cool air is heavy, the fog traps pollutants and prevents them from escaping into the upper atmosphere. This is known as thermally stable (unchanging in temperature) air. In normal (unstable) conditions, as the air near the earth's surface is warned, it rises, carrying the pollutants with it, and is replaced by cooler, cleaner air from above. London-type pollution ends when the temperature rises, warming the polluted air and causing it to rise to higher altitudes.

Air Inversions Trap Poisons

Los Angeles-type pollution is somewhat more complicated. It is caused by what is known as an inversion layer, when a sudden change in temperature causes air at higher altitudes to become warmer than air near the ground, thus causing a thermally stable atmospheric condition which traps smog and other pollutants. In Log Angeles, such inversions often form between the three mountain ranges which enclose the metropolis on days where the temperature rises above 75^{o}. When this happens, enormous concentrations of hydrocarbons from industrial smokestacks and automobile exhausts build up in the warm air surrounding the city. These substances interact with strong sunlight to produce a very irritating smog. With Log Angeles-type smog, the level of pollution drops at sunset when the upper atmosphere cools, breaking the inversion.

With either London or Los Angeles-type pollution, there are two ways in which the situation can be improved--a change in weather conditions or a reduction in the amount of pollutants being poured into the air from industries, automobiles, and other sources. Only nature can provide the former. When she fails to do so, it seems apparent that man will be obliged to provide the latter.

TEACHER COMMENT NO. 11:

Population To Grow By 50 Million By 2,002, Film Says

Judith Randal

WASHINGTON — Item: Any way you slice it, there will be at least 50 million more Americans 30 years from now than there are today. And that's by the most conservative estimates — i.e. if the children who were born during the World War II baby boom only replace themselves.

Item: Although the poor and the black are widely supposed to be the groups chiefly responsible for population growth, the truth is that, in this country at least, seven out of every 10 births are to the white middle class.

Item: A child born this year will vote for president in 1992 and will enter the job market by about 1995. Half his children will be born in this century and half in the 21st. He will become a grandfather about 2020, will retire about 2035 and will die about halfway into the next century.

These statements will be familiar if you saw the filmed report of the Commission on Population Growth and the American Future when it was shown on public television.

BUT WHAT may come as a surprise is that the commission — which was created by Congress, appointed by the President and paid for by the taxpayers — has had to rely almost entirely on the private sector to get its findings aired.

Indeed, the White House has paid so little attention to the report and its sobering conclusions that the commission sought support from foundations so that its content could be made known to the public through the medium of film.

The reasons for this can be traced to the apparent sacrifice of the two-year study to election-year politics. When, last spring, the commission assembled a thoughtful document that examined the issues posed by population growth and recommended a series of voluntary containment measures, President Nixon did not respond to the report as a whole.

INSTEAD, with the campaign just heating up, he chose to single out three inflammatory topics as if to say the commission had dealt with nothing else.

This would have been bad enough if he had accurately reflected its views on abortion, sex education and the distribution of contraceptives to minors. But Mr. Nixon chose not to do this and, by saying that he did not "support unrestricted abortion policies . . . (or) unrestricted family planning services and devices to minors," gave the misleading impression that the commission had come out in favor of these things and advocated wanton sex.

For the record, what it really means is population control, but that abortion should be a private matter between a woman and her physician when contraceptive measures failed. (Five of the 24 commissioners did not go even this far and filed minority statements opposing further relaxation of legal strictures on the willful termination of pregnancy.)

And when it came to family planning services and sex education for minors, the objective was not to encourage promiscuity, but to deal effectively with the realities that young people in this country now become sexually active earlier than ever before, that illegitimacy and venereal disease are rampant, and that ignorance of sexuality is no guarantee of chastity.

More to the point — and this was the real issue addressed by the commission — population size has everything to do with the quality of life.

Already, to drive on American streets and highways is to encounter abysmal traffic jams. Already, to be angry about welfare costs and other tax-supported social programs is to express a reluctance to support the growing numbers of the very young, the very old and the ill and handicapped that unchecked population growth surely would bring.

ALREADY, our overcrowded national parks and recreation areas speak to a scarcity of land to be enjoyed. And already the size of our population threatens the dignity of the individual, increasing his risks of loneliness and alienation and making him increasingly expendable all across the board.

Nor is it true, as many still believe, that a bigger America will necessarily be stronger either militarily or economically. The day is past when governments need to encourage large families to be sure of enough cannon fodder for future wars; the increased fire power of modern weaponry and other technological "advances" have seen to that.

And the conventional wisdom that more people bring with them more prosperity also rings false. In this age of automation, further industrialization, while almost certain to produce more pollution, also can result in fewer jobs.

IN SHORT, the seeds of the future already have taken root and what has been dealt with by the commission is too important to have been consigned to oblivion by political expediency.

Today, November 30, 1972

TEACHER COMMENT NO. 12:

World Wary of Population Control

By GEORGE BRIA
Associated Press Writer

UNITED NATIONS, N.Y. — A 63-year-old father of six who feels his generation was shortsighted in population planning is in a key spot to make amends.

Antonio Carrillo Flores, former Mexican foreign minister, heads the most ambitious attempt yet to deal with the complex and controversial issue on a global scale. He is secretary-general of the World Population Conference to be held in August 1974. The world's population will have doubled by the year 2006 if the present 2 percent rate of growth continues.

"First of all, you have to try to assure every country that in coming to the conference it is not commiting itself to a birth control program," Carrillo Flores says in discussing one of the most sensitive points.

"Some countries have already asked, 'Well, if there is too much population in the world why should certain countries be pinpointed to reduce their population? Why aren't others asked to reduce theirs? Especially since the consumption and use of natural resources by the inhabitants of the rich countries are much greater?'

"It is very important that the poor countries, the developing countries, don't get the impression that the rich countries are telling them, 'You reduce your population and all your problems will be solved.'"

With these thorny issues, among others, facing the conference, Carrillo Flores told an interviewer: "I don't think it's constructive to try to devise a single formula. Even if you were to come to the conclusion that the world as a whole has a problem because its population is growing too fast, it would not be constructive to present the problem that way. No country will define its policy by taking into consideration as a No. 1 priority the problems of the world. We are living in a world in which every country considers its national interests first.

"The main fruit that I expect from the conference is to arouse the interest of every country so that it will face its own problem."

In announcing Carrillo Flores' appointment, U.N. Secretary-General Kurt Waldheim voiced hope that the conference will deal with all aspects of demographic problems, including moral ones. He observed:

"From the start of its involvement in population matters it has been a fundamental tenet of the United Nations that there must be freedom of choice for individuals to shape their family life according to their beliefs and aspirations, and for governments to pursue the policies that are most in keeping with the physical and spiritual welfare of their people."

Agreeing with this, Carrillo Flores says that at the Tehran conference on human rights held in 1968 the United Nations declared the right of every individual and every family to determine its own size.

But he adds: "Every individual has also the right to obtain the information that may enable him to make a free and responsible decision. It's a question in which education plays a very important role."

The conference site has not been chosen yet. At preparatory symposia in Cairo, Stockholm, Kiev and the Hague experts will discuss population and economic development, environment, well-being of the family and human rights.

A group of distinguished personalities is also working on a world plan of action which Carrillo Flores believes could produce a key resolution at the 1974 conference. It would concern assistance.

nical and financial assistance from the U.N. in dealing with the population problem. I don't think the other countries will be opposed to that," Carrillo Flores says, "especially if we are careful in safeguarding two vital points — the sovereignty of every country and the rights of the individual."

Carrillo Flores is a member of a distinguished Mexican Indian family. His father, Julian Carrillo, was a composer, a pioneer in fractional tone music. A brither of Carrillo Flores, Nabor, was rector of the University of Mexico. Antonio Carrillo Flores was ambassador to Washington, finance and foreign minister and dean of the law school. He and his wife, a teacher, have six grown children, four boys and two girls.

Born in a village now overrun by Mexico City's urban sprawl, Carrillo Flores became interested in population trends 25 years ago when he headed a public corporation promoting Mexico's economic development

Although Mexico faced a doubling of its population in less than 20 years, all the government leaders of that time "believed the question could not be approached without the support of the people because it was a sensitive moral and religious question," Carrillo Flores recalls.

"Perhaps my generation should have done more in presenting the population problem to the Mexican people," he says. "It is more and more difficult to get jobs for the people . . . but the times were not ripe in Mexico to face the problem."

FOCUS

'Antonio Carrillo Flores, former Mexican foreign minister and father of six, regrets his generation's attitude toward birth control. As head of an upcoming U.N. World Population Conference, he wants to get more nations to consider the problem. 'We are living in a world where every country considers its national interests first,' he notes. 'No country will define its policy by considering the problems of the world. 'But the worldwide population problem remains, and Flores keeps working on it.