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ABSTRACT

This paper describes a physics course at Eastridge High School in Rochester, New York, which is highly adaptable to a variety of student interests and needs. Three content streams in Physical Science Study Committee (PSSC), Project Physics and New York State Regents physics are contained in one course. Individual materials for all three streams have been developed. All three proceed at the same time in a single integrated classroom-laboratory. Laboratory work proceeds at the same time as all other activities. The student assignments are made for six time blocks through the school year with no deadlines within each block. Each assignment consists of basic requirements with optional materials provided. Included are sample topic assignment sheets, option plan for grading, student record card, and the Project Physics schedule for one year. (TS)

An Alternative Plan in High School Physics (1)

by

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and

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At Eastridge High School we have introduced a physics program that is highly adaptable to a variety of student interests and needs. We feel that in the view of the students themselves it provides a real and effective alternative to the traditional or standard high school physics course.

We have abandoned our former organization: four classes of New York State Regents physics and one class of PSSC physics. Instead, we now offer only a single course, which our course list designates simply "physics." The internal organization of the course permits a student to follow any one of three content streams. Stream P is PSSC physics, third edition. Stream Q is Project Physics. Stream R is New York State Regents physics. We have developed individualized materials for all three streams, and all three proceed at the same time in a single classroom.

The motives for change were a number of negative factors that seemed tied to the traditional instructional format. The familiar cycle of lecture, demonstration, problems, discussion of problems, and test became increasingly deadening to our students---and to us. In attempts to resolve the matter we found that up to 80 percent of our students were either not listening or did not understand what we were trying to explain. Laboratory sessions, which are supposed to be a bright spot in science courses, were viewed by students as irrelevant---an unnecessary and additional burden placed on them by the teachers. Boredom, frustration, and dismay were frequent reactions of both students and teachers.

The key element in our alternative plan is the complete abandonment of the traditional lecture presentation. This is in accord with good pedagogical principle but far from common practice in schools we have observed, including our own.

It has become a rule in our alternative plan to talk to classes as a whole as little as possible. We strictly limit addressing the group to announcements and the conduct of classroom routine. We also discarded the fixed laboratory period and the scheduled test, which we also considered major obstacles to significant change.

In developing an alternative plan we had three objectives: (1) there should be provision for student choice as to content; (2) there should be some provision for student choice as to method of learning; (3) to the extent possible the significant learning activities should take place in the physics classroom during regular school hours.

After two full years of experience we feel that the three streams provide a satisfactory choice as to content. Our most able students choose the PSSC materials; they are in a definite minority of 10 percent or less of our total enrollment. The remainder of students is divided about equally between Project physics and Regents physics. The Project students are a heterogeneous group, ranging from very strong in ability to quite weak. Typical reasons for choosing Project are: "less mathematical" or "it looks more interesting." Regents students show a narrower spectrum of interests and are more concerned with meeting diploma requirements. All three courses have equal credit standing.

After discussion and observation we concluded that students learn physics best when working informally in small groups of two or three. We therefore provide a classroom setting that is informal. We permit students to communicate freely, to discuss problems and laboratory work in small groups, to move about the room freely on routine matters.

We have an integrated classroom-laboratory, and laboratory work proceeds at the same time as all other activities. Equipment for a variety of experiments is kept out and available on the laboratory tables. We also have a filmstrip viewer, casette player, and film-loop projector. Students may sign out of class to the library or a study hall. They may also bring specific questions and problems to the teacher in a one-to-one conference. During scheduled class periods the major portion of the teacher's time is spent in work with individual students.

Over the longer term students prefer to work to a schedule, but they want relief from an endless series of rigid deadlines. Our compromise has been a "block system." The school year is divided into six time blocks. At the end of each block the student must have completed all basic assignments made within the block. However, during the six-week block he is free to pace himself as he sees fit.

The setting has changed, but the task of the student remains much the same: reading, problems, experiments, discussion, tests. Since the teacher is no longer the principal source of information, the student must be provided with a study guide (i.e. contract, job sheet) which provides sufficiently detailed directions to permit the student to work through the materials of the course without the constant attention and direction of the teacher.

A well prepared study guide is the absolute essential to successful individualization of learning, and in our experience preparing and revising study guides accounts for the major fraction of our preparation time. In the case of our alternative plan we have had to develop study guides for each of the three content streams.

Beyond this we provide students with as much individual material as resources allow. We do not have teaching machines, computer assisted instruction, or closed circuit television. But we do have a good library, an adequate inventory of physics apparatus, a good collection of supplementary text books, access to films and filmstrips, relatively unlimited use of a Xerox 2400 copier, and occasional clerical help.

To extend the opportunity for students to exercise their own judgement we have devised a grade option plan. Our practice in the past has been to give all students approximately the same task; grades were based on the resulting achievement. Now students may plan for definite grade goals under the option plan, which provides differing task combinations, which in turn lead to different grades. To a large degree students choose the grade they want and then go about meeting the requirements indicated by the option plan.

Under the option plan the various activities of the course are classed as "basic" or "optional." Satisfactory completion of all basic activities in general leads to a grade of C. Students desiring higher grades work out various combinations of optional activities that lead to the selected goal. Achievement tests are important, but not all-important. A student achieving D on tests may earn a course grade as high as C+. On the other hand, the student who achieves A+ on tests cannot earn a course grade higher than C unless he completes the optional work required for a higher grade. The grade option plan has had the effect of better fitting the demands of the course to the ability and motivation of the student.

In testing procedures we have departed from our past practice, which provided little alternative to the very weak or failing student. We now permit students to re-take tests, using either alternate forms or in some cases the same test.

Based on the judgement of the teacher, students scoring low but not failing may also be retested. Between sessions the student analyzes and corrects his weaknesses, conferring with the teacher if necessary.

The paragraphs above briefly outline the major elements in our alternative plan for teaching physics. To help complete the picture we have tried to convey, we have appended a few samples of materials used by students in their day to day contact with the course. These include (1) student study guide (2) performance objectives (3) grade option plan (4) student record card (5) course calendar (6) guide to outside reading.

Our alternative plan is now in its third year of operation. The majority of students show a definite preference for the freedom of choice in content, time, movement and tasks that the course provides. As teachers we are aware of a profound change in the psychology of the classroom. The role and strategy of the student have changed from passive receiver of information to active participant in the planning and process of his own learning.

The role of the teacher has changed from dispenser of information to planner and organizer of learning activities and close counsellor of students. The mild tension and hostility of the traditional adversary climate---pupil versus teacher---has disappeared. There are virtually no discipline problems. Pupil achievement overall is as good as it was under the traditional plan, if not better. Physics enrollment has increased slightly because of the developing reputation of the way the course is handled.

On the other hand there are some definite problems. It quickly becomes clear that the student himself is the principal agent in securing his own success. Many pupils who are accustomes to blaming the teacher or the school for their failure are uncomfortable in the new role. The negative effect is compounded when habitually passive pupils see the teacher steadfastly refuse to go through the motions the pupil identifies as "teaching" (i.e. telling the class what to do).

The three content streams, the individualization of materials and tasks, the grade option plan, and the informal organization of the classroom combine to make an extremely diverse and interesting scene. Within its limits we find our alternative plan to be an answer---at least for the present---to the growing boredom and frustration of high school pupils.

Course: Regents XX Project ____ PSSC ____

Unit ~~XXXXXXXX~~ 6 Topic Heat and Kinetic Theory

Schedule: 10 days; dates: November 29-December 3; Dec. 6-10, 1971
(See note below.)

	Resources	Basic	Optional
Core	(See note below.) 1. Text book	Chapt 9: Sec. 1-4, 6 Chapt 10: Sec. 4-6,	Sec 7-9
	2. Equations	9-2, 10-6	10-8
	3. Questions	Ch. 9: 3-7, 13, 14. Ch. 10: 5, 6, 7, 9, 10, 11, 12.	Ch. 10: 13
	4. Problems	Ch. 9: 8-11, 14, 16, 20. Ch. 10:10, 12, 13, 15.	Ch. 9: 12, 13, 17. Ch. 10: 18, 19.
	5. Laboratory	No. 9 Specific Heat of a Metal (See teacher for instruction sheets)	No. 10: Heat of Fusion of Water
Extended	6. Visuals		
	7. Film		
	8. Filmstrips	# 619 Heat and Temperature---Molecular Energy; #A482-3 Heat and How it is Measured (somewhat elementary).	
	9. Demonstration		
	10. References:		Note: Material for this unit is taken from two chapters of the text book. Read assignment carefully. In Chapt. 9 Sec. 5 should be omitted. In Chapt. 10 Sec. 7-9 should be read for the ideas but not the mathematics. Sec. 1 and 2 should be omitted.
	Taffel	Chapts. 11-14.	
	White	Lessons 43, 49.	
	Genzer		
	PSSC		
	Lehrman		
	Marantz	Chapts. 9-10.	
	Project		
	11. Outside reading	Project Physics Reader No. 3 (particularly articles 1-12); Count Rumford by Sanborn Brown; Water---the Mirror of Science by Kenneth Davis and John Day; Near Zero by D.K.C. MacDonald (the books are in our library); Scientific American, August 1967, "Robert Boyle."	

Unit 1: Kinematics Achievement Level: 1-2

1. Define: (a) linear motion (b) displacement (c) speed (d) motion at constant speed.

2. Write: an equation that shows the relationship of displacement, speed, and time for motion at constant speed.

3. State: the units of displacement, speed, and time in the MKS metric system.

4. Solve: problems relating to motion at constant speed.

5. Define: (a) accelerated motion (b) uniform acceleration.

6. Write: an equation, using delta notation, that states the relationship of acceleration, change in speed, and time interval.

7. State: the MKS units of acceleration.

8. Write: an equation that defines average speed in terms of total distance traveled and total time elapsed.

9. Define: instantaneous speed (i.e. when speed is not constant).

10. Write: an equation that defines average speed during an interval of time in terms of the initial and final speeds (when acceleration is uniform).

11. Write: an equation that shows the relationship of distance traveled to acceleration (uniform) and time.

12. Solve: problems relating to uniformly accelerated motion using the equations referred to above.

13. Sketch: graphs of (a) displacement vs. time (b) speed vs. time (c) acceleration vs. time for motion at constant speed and for motion with uniform acceleration.

14. State: the physical significance of the slope of the graph of (a) speed vs. time (b) displacement vs. time.

15. State: the physical significance of the area under the graph of (a) speed vs. time (b) acceleration vs. time.

16. Solve: problems relating to uniformly accelerated motion by using the properties (slope, area) of the graphs of the motion.

17. Solve: problems relating to the uniformly accelerated motion of an object in free fall (a) near the earth's surface (b) near the surfaces of other planets when sufficient data is known.

Eastridge Physics

<u>GRADE OPTION PLAN</u>

Grade to be earned	Test average	Problem work	Laboratory work	Background reading
A	B	Basic and <u>all</u> optional problems	All basic and two optional experiments	Four reports
A	A			Three reports
B	C	Omit one optional problem assignment	All basic and one optional experiment	Two reports
B	A or B			One report
C	D	Basic problems only	Basic experiments only	One report
C	C			None
C	A or B			
D	D		Minimum laboratory work (consult teacher)	

Grades of A+, B+, C+, and D+ will be given at the discretion of the teacher, based on overall quality of work submitted.

JONES, SALLY

	P	L	R	T					
					14				
1	√√	√	√	B	15				
2	√√	√√	√	C+	16				
3	√√	√			17				
4					18				
5					19				
6					20				
7					21				
8					22				
9					23				
10					24				
11					25				
12					26				
13					27				

REGENTS

28				
29				
1	B	2		REPORT CARD
2				
3				
4				
5				
6				
1	4	M	W	LAB DAYS
2				
3				
4				
5				
6				

Numbers = units or chapters. P = problem work; one check = satisfactory basic work; two checks = satisfactory basic and optional work. L = laboratory exercises. R = outside reading.

Project Physics Schedule---1971-72

MP	Wks	Date		Chapter and Topic	
	1.	Sep	7-10		
	2.		13-17	1	Language of Motion
	3.		20-24	2	Free Fall
1	4.		27-1	3.	Birth of Dynamics
	5.	Oct	4-8	4.	Understanding Motion
	6.		12-15		
	7.		18-22		
	8.		26-29	5	Where is the Earth
	9.	Nov	1-5	6	Does the Earth Move
2	10.		8-12	7	A New Universe
	11.		15-19	8	Unity of Earth and Sky
	12.		22-24		
	13.		29-3		
	14.	Dec	6-10	9	Conservation of Mass and Momentum
	15.		13-17	10	Energy
3	16.	Jan	3-7	11	Kinetic Theory of Gases
	17.		10-14	12	Waves
	18.		17-21		
	19.		24-28		
	20.	Feb	31-4	13	Light
	21.		7-11	14	Electric and Magnetic Fields
4	22.		14-17	15	Faraday
	23.		22-25	16	Electromagnetic Radiation
	24.		28-3		
	25.	Mar	6-10		
	26.		13-17	17	Chemical Basis Atomic Theory
	27.		20-24	18	Electrons and Quanta
5	28.		27-28	19	Rutherford-Bohr Atom
	29.	Apr	10-14	20	Modern Physical Theory
	30.		17-21		
	31.		24-28		
	32.	May	1-5		
	33.		8-12	21	Radioactivity
	34.		15-19	22	Isotopes
6	35.		22-26	23	The Nucleus
	36.		30-2	24	Nuclear energy
	37.	Jun	5-9		
	38.		12-16		
	39.		19-23		

Eastridge Physics Course

Guide to Outside Reading

The purpose of the optional reading assignment is to extend your understanding of the ideas of physics and to build background in areas that are not always directly related to the basic core material of the course.

The unit or chapter study guide will usually make suggestions for outside reading or you may find your own material. In any case, you are urged to use the library for this assignment. (This does not apply to the Project Physics Readers, which are kept in the physics room.)

A single outside reading assignment should range from 10 to 25 or 35 pages. Thus an article from Scientific American or a chapter from a book would satisfy the requirement. If you plan to read a single length piece of material, check with the teacher to see how it will fit the requirements you are trying to meet.

The written report on your reading should be brief and informative. The material should be completely identified: title, author, source, etc. Follow all the rules of grammar and usage that you have learned in your English classes. Submit the report on standard-size paper, written in ink or ball-point, or typed. The content of the report should briefly state what you learned or how you reacted to what the author said. The finished report should be about 150 to 500 words, i.e. 1 or 2 pages on normal handwriting.