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ABSTRACT

This unit of instruction introduces the measuring of work, power, and energy; forms of energy; conversion and conservation of energy; and types of machines. It is a course suggested for the terminal science student. No requisites for prior course work are suggested. The booklet lists the state-adopted texts in the list of references. It states the performance objectives and the course outline. Experiments, demonstrations, projects, and problems are found in the booklet. Relevant films available from the Dade County Audiovisual Center are listed, and a master sheet is provided relating each suggested activity to the specific performance objectives. (EB)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

ENERGY AND WORK

5348.05

SCIENCE

(Experimental)

DADE COUNTY PUBLIC SCHOOLS

DIVISION OF INSTRUCTION • 1971

ENERGY AND WORK

5348.05

SCIENCE

(Experimental)

Written by Paul L. Piotts
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida
1972

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ENERGY AND WORK

COURSE DESCRIPTION

This course introduces the measuring of work, power and energy; forms of energy; conversion and conservation of energy; and types of machines. It is oriented toward practical application.

ENROLLMENT GUIDELINES

None. Suggested for the terminal science student.

STATE ADOPTED TEXTS

See References.

PERFORMANCE OBJECTIVES

1. Given sufficient data the student will analyze motion by constructing graphs.
2. The student will state Newton's three laws of motion.
3. Given selected vector quantities, the student will solve problems by use of vector diagrams.
4. Given a laboratory experience, the student will distinguish between circular motion and the motion of a pendulum.
5. Given the definition of work, power and energy, the student will solve mathematical problems involving work, power and energy.
6. The student will differentiate between kinetic and potential energy.
7. Given sufficient class experience, the student will identify five types of energy.

PERFORMANCE OBJECTIVES (Continued)

8. Given a variety of laboratory experiences, the student will describe energy changes.

9. The student will give examples of the laws of conservation of energy and matter.

10. Given a list of selected machines the student will classify them according to directions provided in class.

11. Given the same selection of machines, the student will explain the function of each.

12. Using cloud chamber diagrams, the student will identify Alpha, Beta and Gamma radiation.

COURSE OUTLINE

I. Motion

   A. Definition

   B. Causes

   C. Directions

   D. Types

   E. Laws

II. Applications of Motion

   A. Work

   B. Power

   C. Energy

III. Energy

   A. Types

   B. Conversion

   C. Conservation

COURSE OUTLINE (Continued)

IV. Applied Energy

A. Work

B. Machines

C. Engines

EXPERIMENTS

Abraham, Norman. Interaction of Matter and Energy - Teacher's Edition. Chicago: Rand McNally and Company, 1969.

1. Observing effects of electrical charges (p. 46)
2. Friction (p. 149)
3. Motion and the force of gravity (p. 157)
4. Measuring acceleration (p. 160)
5. Analysis of momentum (p. 172)
6. Energy of motion (p. 175)
7. A study of the pendulum (p. 184)
8. Energy transfer (p. 208)

Berner, Stephen P. Introduction to Matter and Energy - Teacher's Manual. Illinois: Learning Materials Inc., 1964.

9. Does energy come in kinds and quantities? (p. 31)
10. Can a spring be given potential energy? (p. 33)
11. How does heat affect matter? (p. 36)
12. How are different kinds of energy related? (p. 38)
13. What is inertia? (p. 34)

Blanc, Sam S. Exercises and Investigations for Modern Science - Man, Matter, and Energy. New York: Holt, Rinehart and Winston, Inc., 1967.

14. Centrifugal force (p. 113)
15. Wave forms (p. 61)

EXPERIMENTS (Continued)

Brandwein, Paul F. Teacher's Edition - Concepts in Science 4. New York: Harcourt, Brace and World, Inc., 1966.

16. Waves (p. 13)
17. Making light (p. 45)
18. A chemical change that makes light (p. 47)

Fisk, Dr. Franklin G. The Physical Sciences - Investigating Man's Environment. Illinois: Laidlaw Brothers, 1971.

19. Definition of Newton's Laws of Motion (p. 561)

Gaskin, Theodore A. Extending Your Knowledge - Science 4. New Jersey: Silver Burdett Company, 1966.

20. Absorbing energy (p. 73)
21. Light to heat to electricity (p. 79)

Gross, Jesse. Study Lessons in General Science - Unit One Introduction To Matter and Energy. Chicago: Follett Publishing Company, 1968.

22. What is energy ? (Exp. 2, p. 3)
23. Conservation of matter and energy (Exp. 1,2, p. 36)
24. Elements, compounds, and mixtures (Exp. 1,2, p. 44)

Gross, Jesse. Study Lessons in General Science - Work and Energy. Chicago: Follett Publishing Company, 1969.

25. Work, energy, and force (Exp. 1,2, p. 7)
26. Work and energy are related (Exp. 1, p. 14 - Exp. 2,3, p. 15)
27. How to make a pinwheel turn (p. 15)
28. How machines use energy (Exp. 1,2, p. 21)
29. Simple tools are machines (Exp. 1, p. 27)
30. Steam engines (Exp. 1,2, p. 39)
31. The use of electrical energy (Exp. 1,2,3, p. 50)

Oxenhorn, Joseph M. Pathways in Science - Laboratory Workbook Chemistry One. New York: Globe Book Company, Inc., 1971.

32. Which materials conduct electricity and heat? (p. 15)

EXPERIMENTS (Continued)

Oxenhorn, Joseph M. Pathways in Science - Matter and Energy. New York: Globe Book Company, Inc., 1968.

33. How is motion related to energy? (p. 22)

Oxenhorn, Joseph M. Pathways in Science - Laboratory Workbook Physics One. New York: Globe Book Company, Inc., 1971.

34. How can resistance be useful in electrical appliances? (p. 3)
35. How does an electromagnet work? (p. 7)
36. Can magnetism make electricity? (p. 13)
37. Can you make electricity from chemicals? (p. 27)
38. How two dry cells are connected to give more power than one (p. 31)
39. Through what materials can electricity flow? (p. 37)
40. How is magnetism related to electricity? (p. 45)

Ruchlis, Hy. Classroom Laboratory 3 - Concepts in Science. New York: Harcourt, Brace and World, Inc., 1966.

41. Energy at work (p. 18)
42 The water wheel (p. 41)

Weisbruch, Fred T. Patterns and Processes of Science - Laboratory Text No. 3. Boston: D. C. Heath and Company, 1968.

43. The effect of variables on the period of the pendulum (p. 22)
44. Prediction in scientific method applied to a study of flames (p. 58)
45 Force vs. stretch for a spring - an introduction to graphing (p. 161)
46. Time of heating water vs. temperature (p. 187)
47. The law of the pendulum (p. 217)
48. Range of a projectile (p. 227)
49. Relationship between temperature and the cohesive force of water (p. 298)
50 Heat energy liberated in a chemical reaction (p. 375)
51. Initial and final temperature of mixture (p. 439)
52. Heat exchange between different substances (p. 445)
53. Specific heat of aluminum (p. 450)
54. The effect of temperature change of solids (p. 453)
55. Motion of constant speed (p. 492)
56. A study of motion at terminal velocity (p. 500)
57. Acceleration (p. 507)

DEMONSTRATIONS

Abraham, Norman. Interaction of Matter - Teacher's Edition. Chicago: Rand McNally and Company, 1969.

1. Electrostatic change (p. 45B)
2. Electricity and light (p. 260)
3. Heat and electricity (p. 262)

Blanc, Sam S. Exercises and Investigations for Modern Science - Forces, Change, and the Universe. New York: Holt, Rinehart and Winston, Inc., 1967.

4. The relationship between force, mass, and acceleration (p. 61)

Blanc, Sam S. Exercises and Investigations for Modern Science - Man, Matter, and Energy. New York: Holt, Rinehart and Winston, Inc., 1967.

5. Radiant energy (p. 39)
6. Energy from the sun (p. 41)

Grass, Jesse. Study Lessons in General Science - Unit One Introduction to Matter and Energy. Chicago: Follett Publishing Company, 1968.

7. What is energy? (Exp. 1, p. 31)

Gross, Jesse. Study Lessons in General Science - Work and Energy Chicago: Follett Publishing Company, 1969.

8. Wheels can be machines (Exp. 1,2,3, p. 50)
9. Making a wheel and axle (p. 33)
10. Internal combustion engines (p. 44)
11. How electric motors work (Exp. 1,2, p. 54)

Oxenhorn, Joseph M. Pathways in Science - Matter and Energy. New York: Globe Book Company, Inc., 1969.

12. How does a chemical change release potential energy? (p. 32)
13. How can gravity change potential energy to kinetic energy? (p. 39)

DEMONSTRATIONS (Continued)

Ruchlis, Hy. Classroom Laboratory 2 - Concepts in Science 2. New York: Harcourt, Brace and World, Inc., 1966.

14. Motion of heated air (p. 56)

Ruchlis, Hy. Classroom Laboratory 3 - Concepts in Science. New York: Harcourt, Brace and World, Inc., 1966.

15. The radiometer (p. 38)

Weisbruch, Fred T. Patterns and Processes of Science - Laboratory Text No. 3. Boston: D. C. Heath and Company, 1968.

16. Observations on the pendulum cycle (p. 9)
17. Tracking atomic particles with the cloud chamber (p. 412)
18. Radiation of light energy (p. 467)

PROJECTS AND PROBLEMS

1. Ask the students how they would use Newton's first law to explain why the effect (feeling heavy and then light) is reversed when the elevator travels down.

2. Which of Newton's laws of motion is put into use when a rocket is launched?

3. If a plane is steered southward at a speed of 12 meters per second but is also carried eastward at a speed of 5 meters per second, how fast is the plane traveling?

4. List as many different definitions for the word work as you can (student).

5. Have the students make a list of the many different ways of producing a force.

6. Have the students explain what the letters and the numeral represent ($E = mc^2$).

7. Divide the students into five groups, each of which can select a particular form of energy for study. Have the students in each group list examples of how their form of energy is used in a community.

PROJECTS AND PROBLEMS (Continued)

8. After the students have learned about the chain of energy conversions in a power plant, have them apply their understanding of energy conversions to an explanation of the energy changes in a water cycle.

9. One of the greatest scientific theories ever proposed was Einstein's law of conservation of mass-energy. Have the students look up the life and works of Einstein in reference books in the library. Then by role playing, let the students stage a mock interview in which they use the information they have obtained. Let one student play the role of Dr. Einstein and several other students play the roles of reporters from leading newspapers. Plan the interview so that the questions and answers will pertain to Einstein's life and his work.

10. Have the students make a list of factors which would tend to reduce the efficiency of machines. Have the students give specific examples of such factors and where they might be found.

11. Assign a group of students the task of using references to find out all they can about a particular type of heat engine.

12. What is a Wankel engine?

13. Tiny flashes of light produced by alpha particles on a phosphorescent screen can be observed by using an instrument called a spinthariscope. The source of the alpha particles is a small quantity of radium salt placed on a pin which is mounted inside a short tube. The tiny flashes of light that result when the particles strike the phosphorescent screen are magnified by means of a lens which covers one end of the tube. Tubes of this kind are available in some toyshops. They are also available from scientific-equipment companies.

14. Have a student make a model of an atomic reactor, using clay to represent the graphite and short wooden dowels to represent the rods of uranium.

DADE COUNTY 16 mm FILMS

1. Atomic Power
AV#1-10918, 19', B/W

2. Automation and Robot Machines
AV#1-30778, 26', B/W

3. Combustion
AV#1-10741, 15', C

DADE COUNTY 16 mm FILMS (Continued)

4. Evolution of Power
AV#1-03553, 11', C

5. Exploring Electromagnetic Energy
AV#1-10751, 14', C

6. Fire Science
AV#1-10927, 15', C

7. Forces
AV#1-10697, 14', C

8. Gasarama
AV#1-31165, 28', C

9. How Electricity is Produced
AV#1-01911, 11', C

10. Laws of Conservation of Energy and Matter
AV#1-01753, 8', C

11. Magnetic Force
AV#1-30321, 29', C

12. Matter and Energy
AV#1-01731, 10', B/W

13. The Pendulum
AV#1-01737, 12', B/W

14. Principles of the Generator
AV#1-01912, 10', B/W

15. Work and Power
AV#1-10684, 14', C

16. Diesel: The Modern Power
AV#1-12987, 21', B/W

17. Force and Motion
AV#1-01748, 10', B/W

18. An Introduction to Jet Engines
AV#1-11445, 15', C

19. Vector Kinematics
AV#1-10688, 16', B/W

DADE COUNTY 16 mm FILMS (Continued)

20. Vectors
AV#1-30262, 28', B/W

21. Work, Energy, and Power
AV#1-10665, 23', B/W

REFERENCES

* 1. Abraham, Norman. Interaction of Matter and Energy - Teacher's Edition. Chicago: Rand McNally and Company, 1969.

2. Berner, Stephen P. Introduction to Matter and Energy - Teacher's Manual. Illinois: Learning Materials Inc., 1964.

3. Blanc, Sam S. Exercises and Investigations for Modern Science - Forces, Change and the Universe. New York: Holt, Rinehart and Winston, Inc., 1967.

4. Blanc, Sam S. Exercises and Investigations for Modern Science - Man, Matter, and Energy. New York: Holt, Rinehart and Winston, Inc., 1967.

* 5. Brandwein, Paul F. Teacher's Edition - Concepts in Science 4. New York: Harcourt, Brace and World, Inc., 1966.

* 6. Fisk, Dr. Franklin G. The Physical Sciences - Investigating Man's Environment. River Forest, Illinois: Laidlaw Brothers, 1971.

7. Gaskin, Theodore A. Extending Your Knowledge - Science 4. Morristown, New Jersey: Silver Burdett Company, 1966.

8. Gross, Jesse. Study Lessons in General Science - Unit One Introduction to Matter and Energy. Chicago: Follett Publishing Company, 1968.

9. Gross, Jesse. Study Lessons in General Science - Work and Energy. Chicago: Follett Publishing Company, 1969.

10. Oxenhorn, Joseph M. Pathways in Science - Laboratory Work Book Chemistry One. New York: Globe Book Company, Inc., 1971.

* 11 Oxenhorn, Joseph M. Pathways in Science - Matter and Energy. New York: Globe Book Company, Inc., 1969.

* State Adopted

REFERENCES (Continued)

12. Oxenhorn, Joseph M. Pathways in Science - Laboratory Work Book Physics One. New York: Globe Book Company, Inc., 1971.

* 13. Ruchlis, Hy. Classroom Laboratory 2 - Concepts in Science 2. New York: Harcourt, Brace and World, Inc., 1966.

* 14. Ruchlis, Hy. Classroom Laboratory 3 - Concepts in Science 3. New York: Harcourt, Brace and World, Inc., 1966.

15. Weisbruch, Fred T. Patterns and Processes of Science - Laboratory Text No. 3. Boston: D. C. Heath and Company, 1968.

* State Adopted

MASTER SHEET--ENERGY AND WORK

Objectives	Texts	Laboratory	Projects	Demonstrations	Films	References
1	1,2,4,15	13,14,44,45,46,48,50, 51,52,53,54,55,56,57		6,16	19,20	1,2,4,15
2	1,3,4,5,6,11,13, 14,15	3,4,5,6,15,16,33,48, 49,55,56,57	1,2,3	4,14,15	7,17,18	1,3,4,5,6,11,13, 14,15
3					19,20	
4	1,2,4,9,15	7,9,14,26,46,47		16	13	1,2,4,9,15
5	9,14	25,26,27,28,29,30,41	4,5,6,10		4,12,15,21	9,14
6	1,2,4,8,11	6,7,8,9,10,14,22		12,13	3,6,8,11,18	1,2,4,8,11
7	1,2,5,7,8,9,4, 15	1,6,7,8,12,17,18,20,22	6	5,6,16	1,4,5,6,7,9, 11,12	1,2,4,5,7,8,9, 15
8	1,2,3,4,7,8,4, 15	20,21,36,37,39,40,44, 50	7,8	1	3,4,5,6,8,9	1,2,4,5,7,8,12,15
9	1,8	23,24	7,8,9	2,3,7	10,12	1,8
10	9,10	31,32	12	8,9,10,11	2,14,16,18	9,10
11	9,12,14	31,34,35,38,42	1,2,10,11,12	8,9,10,11,15	2,14,16,18	9,12,14
12	15		13,14	17	1	15