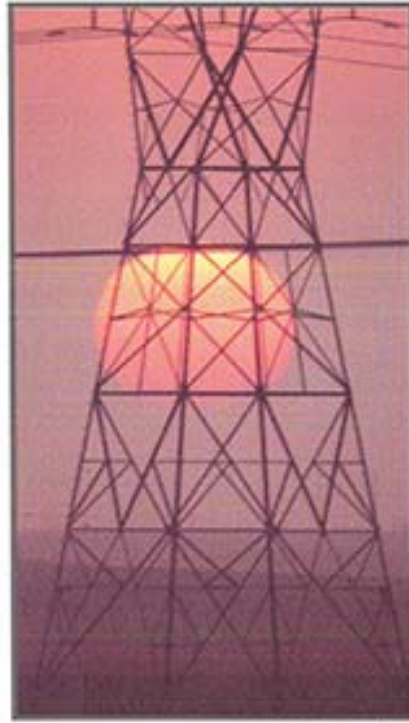


The Properties of Energy

Adapted from an activity by Dr. Ron Canterna
in *Wyoming Energy Curriculum*



— LuRay Parker

Overview

Students make inclined planes and use marbles or steel balls to predict the effect of the energy stored and released by rolling marbles of different sizes down an inclined plane. The activity leads to a working definition of energy that is used to study energy and its conservation.

Objectives

Students will:

- develop an understanding of energy.
- develop an understanding of energy waste and conservation.
- be able to interpret graphs they have made which explain the effect of mass and the height of release on the energy of marbles rolling down an inclined plane.

Grade Levels: 4-6

Time Needed: 30-60 min.

Subjects to Integrate: Science, Math,

Topics: What is energy? What is conservation of energy? energy past, present, and the future.

Skills: observing, communicating, measuring, controlling variables, interpreting data, inferring

Goals and Concepts

A 20; B 3; C 13; E 5; F 7

Materials

Marbles - one each of three different sizes for every group of three or four students

Tracks - stiff cardboard, plastic, or metal strips for the inclined planes

Books to raise one end of the track

Paper cups all of the same size to catch the marbles

Meter sticks

Graph paper

Background

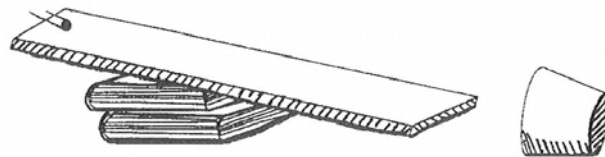
Physicists define energy as the ability to do work. This definition has little meaning to elementary age children. Perhaps a better definition is: "Energy is what makes things happen." A rolling marble running into a paper cup causes the cup to move a certain distance. Energy from the motion of the rolling marble makes the cup move. If the marble is bigger or the marble is moving faster, it will move the cup farther, or cause more movement (do more work by the physicist's definition).

After students discover a definition of energy, they are led to a general understanding of energy in the universe. The energy of the revolving Earth is certainly larger when compared with the moving marble. In our solar system, the sun releases an enormous amount of energy to "make things happen." The energy from the sun drives all the biological processes on Earth. It is constantly being taken in and released to drive biological and many physical processes.

Energy was released in the legs of dinosaurs a long time ago to cause them to move. Even then the energy from the sun was being stored in the plants eaten by dinosaurs and released to "make things happen" for the dinosaur. We move and make things move because of energy stored in our bodies. When we move our bodies to school each morning, we are releasing energy which started at the sun and came to us through the food we eat. The process of releasing energy to make things happen goes on throughout the universe. The sun releases energy when hydrogen atoms combine. Uranium atoms release energy when they are split and sugar molecules release energy when they are changed to carbon dioxide and water in respiration.

Procedure

Each group constructs an inclined plane with a track and places their cup at the end of the track with the top of the cup positioned to catch the marble. All three marbles are released at the same height and the movement of the cup is recorded for each of the marbles as it rolls into the cup. Then the height of the inclined plane is raised and the three marbles are released a second time. The movement of the cup by each of the marbles is recorded again. The height of the inclined plane is raised a third time and the process repeated. Data for the release of each marble is recorded. For each marble, students graph the height of the release in centimeters on one axis of the graph and the movement of the cup on the other.



Releasing the marble

Ask students to study their graphs.

Questions

Do you see a relationship between the height of the marble and the distance it pushes the cup? (As the height is increased, the distance increases.)

How does changing the mass (weight) of the marble affect the distance the cup is moved? (As weight increases, the distance increases.)

Think about the energy of the moving marble. Does it have energy when it is at the top of the incline (before it moves)? (Yes, potential energy.) At the bottom? (Yes, kinetic energy, also known as energy of motion)

What gives the marble its energy? (raising it to the top of the incline)

Understanding Conservation

Ask students to imagine that to move the cup they only have a limited number of tries — and money. It costs to roll the marbles. To release a small marble costs a quarter. To roll the middle sized marble costs fifty cents and to roll the large marble requires a dollar. Ask the student groups to decide on the marble for the particular amount of movement (work) needed. Ask, "Why would you use a particular marble for the movement needed?"

Explain that energy costs money and uses resources. When we drive a car, gasoline explodes in the engine and moves the car. The gasoline costs us money and uses irreplaceable fossil fuels. Earth has a finite amount of fossil fuel energy so there is none to waste. We need to choose our energy uses wisely and practice conservation in the use of this energy.

Extending the Activity

1. Ask students to explain why moving water has energy. (It makes things happen. It moves things.) How did water get to the top of the mountain to flow downhill? (From precipitation, which is part of the water cycle — driven by energy from the sun.)
2. Have students make a list of sources of energy. Which sources can be traced back to the sun?

3. What are ways that our supply of fossil fuels (oil, natural gas, coal) can be conserved? What are the most important uses for this energy?
4. Have students develop reports based on these questions. Or, as groups, they can generate answers and present them in class.

Assessment

1. Ask students to explain their graphs. How does mass (weight) of the marble or steel ball affect the movement of the cup? How does the height of the release of the marble affect the energy of the marble when it reaches the cup?
2. Ask students to explain ways to conserve in these uses of energy: heating a house, driving a car, drying clothes, and building a road.

Wyoming Science Standards

1. CONCEPTS AND PROCESSES

1. In the context of unifying concepts and processes, students develop an understanding of scientific content through inquiry. Science is a dynamic process; concepts and content are best learned through inquiry and investigation.

BENCHMARK K-4

EARTH, SPACE, AND PHYSICAL SYSTEMS

7. Properties of Objects: Students classify objects by properties that can be observed, measured, and recorded.

2. SCIENCE AS INQUIRY

Students demonstrate knowledge, skills, and habits of mind necessary to safely perform scientific inquiry. Inquiry is the foundation for the development of content, teaching students the use of processes of science that enable them to construct and develop their own knowledge. Inquiry requires appropriate field, classroom, and laboratory experiences with suitable facilities and equipment.

BENCHMARK K-4

2. Students use the inquiry process to conduct simple scientific investigations.
 - C. Draw conclusions and accurately communicate results, making connections to daily life
 - D. Pose or identify questions and make predictions
 - E. Conduct investigations to answer questions and check predictions
3. Students identify and use appropriate scientific equipment.
4. Students properly use safety equipment and recognize questions and obtain information from multiple sources to answer them. Students conduct a simple investigation, using their own questions and selecting appropriate tools. They give various logical examples of applications to daily life and/or raise new questions.

Additional Resources

Teaching with Energy, copyright 1992
National Energy Foundation, 5160 Wiley Post Way, Suite 200
Salt Lake City, UT 84116
Activity: "Energy Forms and Conversions"

Goggle: Energy Activities for Elementary School Students:

Energy & Science Lesson Plans Discovery Channel School - The Teacher Channel offers lesson plans for all major ... Rutgers University - lesson plans for elementary students by subject www.energyquest.ca.gov/teachers_resources/lesson_plans.html - 20k - [Cached](#) - [Similar pages](#)

3. HISTORY AND NATURE OF SCIENCE IN PERSONAL AND SOCIAL DECISIONS

Students recognize the nature of science, its history, and its connections to personal, social, economic, and political decisions. Historically, scientific events have had significant impacts on our cultural heritage.

2. Students recognize how scientific information is used to make decisions.

A. Identify and describe local science issues, such as environmental hazards or resource management

B. Suggest feasible solutions and personal action plans to address an identified issue importance of his/her contribution(s). Students take action to address resource conservation issues and evaluate how well it works.

Wyoming Math Standards

CONTENT STANDARD

3. MEASUREMENT Students use a variety of tools and techniques of measurement in a problem-solving situation.

BENCHMARK GRADE 6

4. Students demonstrate relationships within the U.S. customary units for weight and capacity and within the metric system (centimeters to meters) in problem-solving situations. without models. Students use mathematical language to communicate sound reasoning in problem- solving situations.

CONTENT STANDARD

5. DATA ANALYSIS AND PROBABILITY Students use data analysis and probability to analyze given situations and the results of experiments.

1. Students systematically collect, organize, and describe/represent numeric data using line graphs.

2. Students, given a scenario, recognize and communicate the likelihood of events using concepts from probability (i.e., impossible, equally likely, certain) appropriate to grade level.

CONTENT STANDARD

3. MEASUREMENT Students use a variety of tools and techniques of measurement in a problem-solving situation.

BENCHMARK GRADE 5

1. Students apply estimation and measurement of length to content problems using actual measuring devices and express the results in U.S. customary units (parts of an inch-halves/fourths, eights inches, feet, yards, and miles).

2. Students apply estimation and measurement of weight to content problems using actual measuring devices and express the results in U.S. customary units (ounces and pounds).

CONTENT STANDARD

5. DATA ANALYSIS AND PROBABILITY Students use data analysis and probability to analyze given situations and the results of experiments.

BENCHMARK GRADE 5

1. Students systematically collect, organize, and describe/represent categorical data using bar graphs.
2. Students find and interpret mode for data sets in a problem-solving setting appropriate to grade level. Students communicate their findings.
3. Students predict and record outcomes of probability experiments or simulations.

CONTENT STANDARD

3. MEASUREMENT Students use a variety of tools and techniques of measurement in a problem-solving situation.

BENCHMRK GRADE 4

1. Students select and apply appropriate U.S. customary units (half inch, quarter inch, feet, and yards) to the estimation and measurement of length in real-world problems using actual measuring devices.
2. Students select and apply appropriate U.S. customary units (ounces and pounds) to the estimation and measurement of weight in real-world problems using actual measuring devices.

CONTENT STANDARD

5. DATA ANALYSIS AND PROBABILITY Students use data analysis and probability to analyze given situations and the results of experiments.

BENCHMARK GRADE 4

1. Students collect, organize, and compare data in graphs, Venn diagrams, tables, and charts.
2. Students communicate conclusions about a set of data by interpreting information using graphs, Venn diagrams, tables, and charts.
3. Students predict, perform, and record results of probability experiments.
4. Students predict all possible outcomes of a given situation or event.

Wyoming Social Studies Standards

CONTENT STANDARD

3. PRODUCTION, DISTRIBUTION, AND CONSUMPTION

Students demonstrate an understanding of economic principles and concepts and describe the influence of economic factors on societies.

BENCHMARK GRADE 4

1. Students describe the importance of major resources, industries, and economic development of the local community and Wyoming.