

The BIG Idea

Energy Forms and Conservation Energy is the ability to do work or cause change. Energy can be transformed from one form into another, but it cannot be created or destroyed.

1 What Is Energy?

Key Concepts

- If the transfer of energy is work, then power is the rate at which energy is transferred, or the amount of energy transferred in a unit of time.

$$\bullet \text{ Power} = \frac{\text{Energy transferred}}{\text{Time}}$$

- Two basic kinds of energy are kinetic energy and potential energy.

$$\bullet \text{ Kinetic energy} = \frac{1}{2} \times \text{Mass} \times \text{Velocity}^2$$

$$\bullet \text{ Gravitational potential energy} = \text{Weight} \times \text{Height}$$



Key Terms

energy
kinetic energy
potential energy
gravitational potential energy
elastic potential energy

2 Forms of Energy

Key Concepts

- You can find an object's mechanical energy by adding the object's kinetic energy and potential energy.

$$\text{Mechanical energy} = \text{Kinetic energy} + \text{Potential energy}$$

- Forms of energy associated with the particles of objects include thermal energy, electrical energy, chemical energy, nuclear energy, and electromagnetic energy.

Key Terms

mechanical energy
thermal energy
electrical energy
chemical energy
nuclear energy
electromagnetic energy

3 Energy Transformations and Conservation

Key Concepts

- Most forms of energy can be transformed into other forms.
- One of the most common energy transformations is the transformation between potential energy and kinetic energy.
- According to the law of conservation of energy, energy cannot be created or destroyed.

Key Terms

energy transformation
law of conservation of energy
matter

4 Energy and Fossil Fuels

Key Concepts

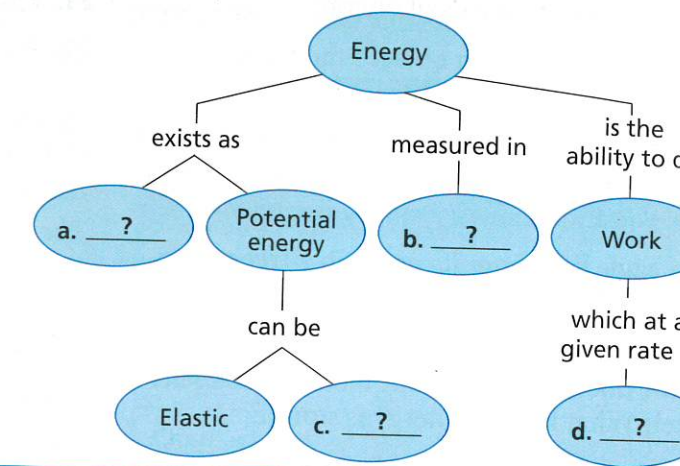
- Fossil fuels contain energy that came from the sun.
- Fossil fuels can be burned to release the chemical energy stored millions of years ago.

Key Terms

fossil fuel
combustion

Organizing Information

Concept Mapping Copy the concept map about energy onto a separate sheet of paper. Then complete it and add a title. (For more on Concept Mapping, see the Skills Handbook.)



Reviewing Key Terms

Choose the letter of the best answer.

- Energy of motion is called
 - kinetic energy.
 - elastic potential energy.
 - gravitational potential energy.
 - chemical energy.
- When you stretch a rubber band, you give it
 - kinetic energy.
 - elastic potential energy.
 - gravitational potential energy.
 - electrical energy.
- The energy associated with the position and motion of an object is called
 - potential energy.
 - nuclear energy.
 - mechanical energy.
 - thermal energy.
- The energy stored in the nucleus of an atom is called
 - electromagnetic energy.
 - electrical energy.
 - chemical energy.
 - nuclear energy.
- Fossil fuels store energy from the sun as
 - chemical energy.
 - thermal energy.
 - electromagnetic energy.
 - electrical energy.

If the statement is true, write *true*. If it is false, change the underlined word or words to make the statement true.

- Kinetic energy is related to an object's height.
- Electrical energy is the total kinetic and potential energy of the particles in an object.
- The law of conservation of energy states that when one form of energy is transformed to another, no energy is destroyed.
- Energy is anything that has mass and takes up space.
- Combustion is the process of burning fuels.

Writing in Science

Interview You are preparing to interview an Olympic skier for a children's science magazine. Prepare a list of questions that you would ask the skier about the energy transformations that occur while skiing.



Energy
Video Preview
Video Field Trip
Video Assessment

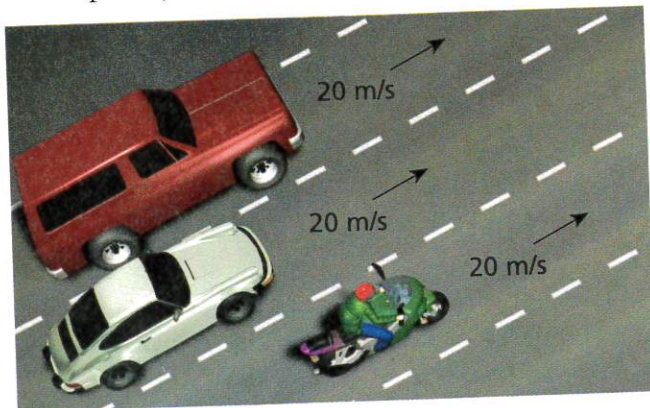
Review and Assessment

Checking Concepts

- Define work in terms of energy.
- How do you find an object's mechanical energy?
- For each of the following, decide which forms of energy are present: a walnut falls from a tree; a candle burns; a spring is stretched.
- An eagle flies from its perch in a tree to the ground to capture and eat its prey. Describe its energy transformations.
- How does energy become stored in a fossil fuel? What kind of energy is stored?

Thinking Critically

- Calculating** Find the power of a machine that transfers 450 J of energy in 9 s.
- Calculating** A 1,350-kg car travels at 12 m/s. What is its kinetic energy?
- Comparing and Contrasting** In the illustration below, which vehicle has the least kinetic energy? The greatest kinetic energy? Explain your answers.



- Problem Solving** A 380-N girl walks down a flight of stairs so that she is 2.5 m below her starting level. What is the change in the girl's gravitational potential energy?
- Applying Concepts** One chef places a pie in the oven at a low setting so that it is baked in one hour. Another chef places a pie in the oven at a high setting so that the pie bakes in 30 minutes. Is the amount of energy the same in each case? Is the power the same?

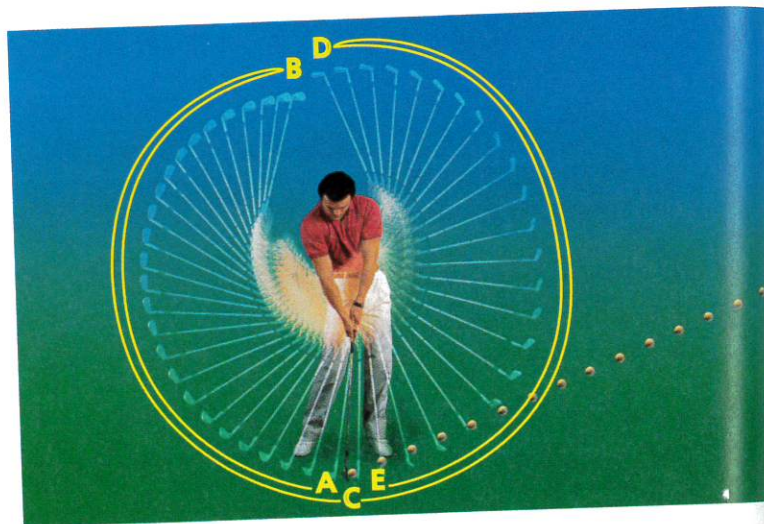
Math Practice

- Exponents** What is the value of 12^2 ?
- Exponents** What is the value of $2^2 \times 3^2$?

Applying Skills

Use the photo to answer Questions 23–25.

The golfer in the photo is taking a swing. The golf club starts at Point A and ends at Point E.



- Inferring** At which point(s) does the golf club have the greatest potential energy? At which point(s) does it have the greatest kinetic energy?
- Interpreting Diagrams** Describe the energy transformations from Point A to Point E.
- Drawing Conclusions** The kinetic energy of the club at Point C is more than the potential energy of the club at Point B. Does this mean that the law of conservation of energy is violated? Why or why not?

Lab zone

Chapter Project

Performance Assessment Present your roller coaster to the class. Explain how you selected your materials, as well as the effect of hill height, incline, turns, and loops on the motion of the roller coaster. You should also explain how energy is transformed as the roller coaster moves along the tracks.

Standardized Test Prep

Test-Taking Tip

Watching for Qualifiers

Qualifiers are words like *most*, *least*, *greatest*, and *best*. When you answer a question with a qualifier, be sure to check and compare *all* the answer choices. Look for the answer that provides the information specified by the qualifier.

Sample Question

The table below gives the kinetic and potential energy of a 6-kg cat doing various activities.

Kinetic and Potential Energy of a Cat

Activity	Kinetic Energy (J)	Potential Energy (J)
Running	200	0
Leaping	150	100
Climbing a tree	3	300
Sleeping on a chair	0	30

The cat has the *greatest* mechanical energy when

- it is running.
- it is leaping.
- it is climbing a tree.
- it is sleeping on a chair.

Answer

The question asked for the cat's greatest mechanical energy. You can find the cat's mechanical energy for each activity by adding its kinetic and potential energy together. The values for climbing a tree (300 J + 3 J) give you the greatest sum (303 J). The answer is C.

Choose the letter of the best answer.

- Wind has energy because
 - it can change direction.
 - it can do work.
 - it has mass.
 - it is electrically charged.

Use the table below and your knowledge of science to answer Questions 2 and 3.

Summer Classic Diving Competition

Name	Weight (N)	Height of Dive (m)
Clark	620	3
Simmons	640	3
Delgado	610	10
Chen	590	10

- When standing on the diving board, which diver has the least gravitational potential energy?
 - Clark
 - Simmons
 - Delgado
 - Chen
- In SI, which unit is used to express the divers' gravitational potential energy?
 - newton
 - kilowatt
 - horsepower
 - joule
- A pendulum will eventually slow and stop because of
 - friction.
 - weight.
 - kinetic energy.
 - potential energy.
- What energy transformation takes place when wood is burned?
 - nuclear energy to thermal energy
 - thermal energy to electrical energy
 - chemical energy to thermal energy
 - mechanical energy to thermal energy

Constructed Response

- Explain the energy transformations involved in how fossil fuels formed and how they are used.