

Chapter Resources

Energy

Includes:

Reproducible Student Pages

ASSESSMENT

- ✓ Chapter Tests
- ✓ Chapter Review

HANDS-ON ACTIVITIES

- ✓ Lab Worksheets for each Student Edition Lab
- ✓ Two additional Laboratory Activities
- ✓ Foldables—Reading and Study Skills activity sheet

MEETING INDIVIDUAL NEEDS

- ✓ Directed Reading for Content Mastery
- ✓ Directed Reading for Content Mastery in Spanish
- ✓ Reinforcement
- ✓ Enrichment
- ✓ Note-taking Worksheets

TRANSPARENCY ACTIVITIES

- ✓ Section Focus Transparency Activities
- ✓ Teaching Transparency Activity
- ✓ Assessment Transparency Activity

Teacher Support and Planning

- ✓ Content Outline for Teaching
- ✓ Spanish Resources
- ✓ Teacher Guide and Answers



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Additional Assessment Resources available with Glencoe Science:

- Exam View® Pro TestMaker
- Assessment Transparencies
- Performance Assessment in the Science Classroom
- Standardized Test Practice Booklet
- MindJogger Videoquizzes
- Vocabulary PuzzleMaker at: gpscience.com
- Interactive Chalkboard
- The Glencoe Science Web site at: gpscience.com
- An interactive version of this textbook along with assessment resources are available online at: mhl.com

To the Teacher

This chapter-based booklet contains all of the resource materials to help you teach this chapter more effectively. Within you will find:

Reproducible pages for

- Student Assessment
- Hands-on Activities
- Meeting Individual Needs (Extension and Intervention)
- Transparency Activities

A teacher support and planning section including

- Content Outline of the chapter
- Spanish Resources
- Answers and teacher notes for the worksheets

Hands-On Activities

MiniLAB and Lab Worksheets: Each of these worksheets is an expanded version of each lab and MiniLAB found in the Student Edition. The materials lists, procedures, and questions are repeated so that students do not need their texts open during the lab. Write-on rules are included for any questions. Tables/charts/graphs are often included for students to record their observations. Additional lab preparation information is provided in the *Teacher Guide and Answers* section.

Laboratory Activities: These activities do not require elaborate supplies or extensive pre-lab preparations. These student-oriented labs are designed to explore science through a stimulating yet simple and relaxed approach to each topic. Helpful comments, suggestions, and answers to all questions are provided in the *Teacher Guide and Answers* section.

Foldables: At the beginning of each chapter there is a *Foldables: Reading & Study Skills* activity written by renowned educator, Dinah Zike, that provides students with a tool that they can make themselves to organize some of the information in the chapter. Students may make an organizational study fold, a cause and effect study fold, or a compare and contrast study fold, to name a few. The accompanying *Foldables* worksheet found in this resource booklet provides an additional resource to help students demonstrate their grasp of the concepts. The worksheet may contain titles, subtitles, text, or graphics students need to complete the study fold.

Meeting Individual Needs (Extension and Intervention)

Directed Reading for Content Mastery: These worksheets are designed to provide students with learning difficulties with an aid to learning and understanding the vocabulary and major concepts of each chapter. The *Content Mastery* worksheets contain a variety of formats to engage students as they master the basics of the chapter. Answers are provided in the *Teacher Guide and Answers* section.

Directed Reading for Content Mastery (in Spanish): A Spanish version of the *Directed Reading for Content Mastery* is provided for those Spanish-speaking students who are learning English.

Reinforcement: These worksheets provide an additional resource for reviewing the concepts of the chapter. There is one worksheet for each section, or lesson, of the chapter. The *Reinforcement* worksheets are designed to focus primarily on science content and less on vocabulary, although knowledge of vocabulary supports understanding of the content. The worksheets are designed for the full range of students; however, they will be more challenging for your lower-ability students. Answers are provided in the *Teacher Guide and Answers* section.

Enrichment: These worksheets are directed toward above-average students and allow them to explore further the information and concepts introduced in the section. A variety of formats are used for these worksheets: readings to analyze; problems to solve; diagrams to examine and analyze; or simple activities or labs that students can complete in the classroom or at home. Answers are provided in the *Teacher Guide and Answers* section.

Note-taking Worksheet: The *Note-taking Worksheet* mirrors the content contained in the teacher version—*Content Outline for Teaching*. It can be used by students to take notes during class, as an additional review of the material in the chapter, or as study notes if students have been absent.



Assessment

Chapter Review: These worksheets prepare students for the chapter test. The *Chapter Review* worksheets cover all major vocabulary, concepts, and objectives of the chapter. The first part reviews vocabulary and the second part reviews concepts. Answers and objective correlations are provided in the *Teacher Guide and Answers* section.

Chapter Test: The *Chapter Test* requires students to use process skills and understand content. Although all questions involve memory to some degree, you will find that your students will need to discover relationships among facts and concepts in some questions and to use higher levels of critical thinking to apply concepts in other questions. Each chapter test normally consists of four parts: Testing Concepts measures recall and recognition of vocabulary and facts in the chapter; Understanding Concepts requires interpretation of information and more comprehension than recognition and recall—students will interpret basic information and demonstrate their ability to determine relationships among facts, generalizations, definitions, and skills; Applying Concepts calls for the highest level of comprehension and inference; Writing Skills requires students to define or describe concepts in multiple sentence answers. Answers and objective correlations are provided in the *Teacher Guide and Answers* section.



Transparency Activities

Section Focus Transparencies: These transparencies are designed to generate interest and focus students' attention on the topics presented in the sections and/or to assess prior knowledge. There is a transparency for each section, or lesson, in the Student Edition. The reproducible student masters are located in the *Transparency Activities* section. The teacher material, located in the *Teacher Guide and Answers* section, includes Transparency Teaching Tips, a Content Background section, and Answers for each transparency.

Teaching Transparencies: These transparencies relate to major concepts that will benefit from an extra visual learning aid. Most of these transparencies contain diagrams/photos from the Student Edition. There is one *Teaching Transparency* for each chapter. The *Teaching Transparency Activity* includes a black-and-white reproducible master of the transparency, accompanied by a student worksheet that reviews the concept shown in the transparency. These masters are found in the *Transparency Activities* section. The teacher material includes Transparency Teaching Tips, a Reteaching Suggestion, Extensions, and Answers to Student Worksheet. This teacher material is located in the *Teacher Guide and Answers* section.

Assessment Transparencies: An *Assessment Transparency* extends the chapter content and gives students the opportunity to practice interpreting and analyzing data presented in charts, graphs, and tables. Test-taking tips that help prepare students for success on standardized tests and answers to questions on the transparencies are provided in the *Teacher Guide and Answers* section.

Teacher Support and Planning

Content Outline for Teaching: These pages provide a synopsis of the chapter by section, including suggested discussion questions. Also included are the terms that complete the blanks in the students' *Note-taking Worksheets*.

Spanish Resources: A Spanish version of the following chapter features is included in this section: objectives, vocabulary words and definitions, chapter purpose, chapter Labs, and content overviews for each section of the chapter.

Reproducible Student Pages

Reproducible Student Pages

■ Hands-On Activities

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Hands-On Activities



Interpreting Data from a Slingshot

Procedure

1. Using two fingers, carefully stretch a **rubber band** on a table until it has no slack.
2. Place a **nickel** on the table, slightly touching the midpoint of the rubber band.
3. Push the nickel back 0.5 cm into the rubber band and release. Measure the distance the nickel travels. Record the measurement in the table in the Data and Observations section.
4. Repeat Step 3, each time pushing the nickel back an additional 0.5 cm.

Data and Observations

Length of Pull (cm)	Distance Traveled (cm)
0.5	

Analysis

1. How did the takeoff speed of the nickel seem to change relative to the distance that you stretched the rubber band?

2. What does this imply about the kinetic energy of the nickel?

TRY AT HOME



Transforming Energy in a Paper Clip

Procedure

1. Straighten a **paper clip**. While holding the ends, touch the paper clip to the skin just below your lower lip. Note whether the paper clip feels warm, cool, or about room temperature.
2. Quickly bend the paper clip back and forth five times. Touch it below your lower lip again. Note whether the paper clip feels warmer or cooler than before.

Analysis

1. What happened to the temperature of the paper clip? Why?

2. Describe the energy conversions that take place as you bend the paper clip.

 (continued)**Conclude and Apply**

1. Calculate the gravitational potential energy of each ball before dropping it.

2. Calculate the average bounce height for the three trials under each condition. Describe your observations.

3. Compare the bounce heights of the balls dropped on a cardboard box with the bounce heights of the balls dropped on the floor. *Hint: Did you observe any movement of the box when the balls bounced?*

4. Explain why the balls bounced to different heights, using the concept of elastic potential energy.

Communicating Your Data

Meet with three other lab teams and compare average bounce heights for the tennis ball on the floor. Discuss why your results might differ. **For more help, refer to the Science Skill Handbook.**



Design Your Own Swinging Energy

Lab Preview

Directions: Answer these questions before you begin the lab.

1. What advantage does a rubber stopper have over a cork stopper as the bob of the pendulum?

2. State the law of conservation of energy.

Imagine yourself swinging on a swing. What would happen if a friend grabbed the swing's chains as you passed the lowest point? Would you come to a complete stop or continue rising to your previous maximum height?

Real-World Problem

How does the motion and maximum height reached by a swing change if the swing is interrupted?

Form a Hypothesis

Examine the diagram in your text. How is it similar to the situation in the introductory paragraph? An object that is suspended so that it can swing back and forth is called a pendulum. Hypothesize what will happen to the pendulum's motion and final height if its swing is interrupted.

Goals

- **Construct** a pendulum to compare the exchange of potential and kinetic energy when a swing is interrupted.
- **Measure** the starting and ending heights of the pendulum.

Possible Materials

ring stand
test-tube clamp
support-rod clamp, right angle
30-cm support rod
2-hole, medium rubber stopper
string (1 m)
metersticks (2)
graph paper

Safety Precautions

WARNING: Be sure the base is heavy enough or well anchored so that the apparatus will not tip over.

Test Your Hypothesis

Make a Plan

1. As a group, write your hypothesis and list the steps that you will take to test it. Be specific. Also list the materials you will need.
2. **Design** a data table on a separate sheet of paper.
3. Set up an apparatus similar to the one shown in the diagram in your text.
4. **Devise** a way to measure the starting and ending heights of the stopper. Record your starting and ending heights in a data table. This will be your control.
5. **Decide** how to release the stopper from the same height each time.
6. Be sure you test your swing, starting it above and below the height of the cross arm. How many times should you repeat each starting point?



(continued)

1. Make sure your teacher approves your plan before you start.
2. Carry out the approved experiment as planned.
3. While the experiment is going on, write any observations that you make and complete the data table.

Analyze Your Data

1. When the stopper is released from the same height as the cross arm, is the ending height of the stopper exactly the same as its starting height? Use your data to support your answer.

2. **Analyze** the energy transfers. At what point along a single swing does the stopper have the greatest kinetic energy? The greatest potential energy?

Conclude and Apply

1. **Explain** Do the results support your hypothesis?

2. **Compare** the starting heights to the ending heights of the stopper. Is there a pattern? Can you account for the observed behavior?

3. **Discuss** Do your results support the law of conservation of energy? Why or why not?

4. **Infer** What happens if the mass of the stopper is increased? Test it.

Communicating Your Data

Compare your conclusions with those of the other lab teams in your class. **For more help, refer to the Science Skill Handbook.**

LAB
1 Laboratory
 Activity

The Energy of a Pendulum

When you ride on a playground swing, you have kinetic energy. Any moving object has kinetic energy, which is the energy of motion. The amount of kinetic energy depends on the velocity and mass of the moving object. If you increase the mass by holding something in your lap or increase the velocity by swinging faster, your kinetic energy increases.

An object at rest may also have energy. When an object is held in a position where it would move if released, it has energy of position, called potential energy. When you begin to swing, a friend may pull your swing back and up. See Figure 1. If the swing is in any position where it can move, you will have potential energy. After your friend releases the swing, you have both potential energy and kinetic energy. See Figure 2.

If you were to sit in the swing while it hung straight down from its supports, you would not move. You are not held in a position where you can move. With reference only to the swing, you have no potential energy and no kinetic energy. See Figure 3.



Figure 1



Figure 2

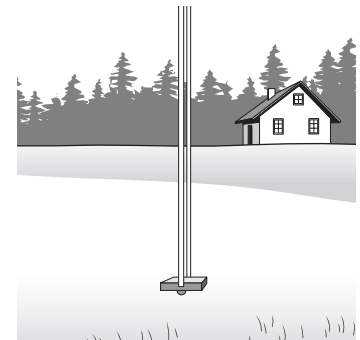


Figure 3

A swing is one example of a pendulum. Many clocks have a swinging mass, or pendulum, to move the hands. A pendulum can have both potential energy and kinetic energy, depending on its position. The amount of energy depends on its mass and velocity. A pendulum hanging straight down, at rest, has neither potential energy nor kinetic energy.

How do potential energy and kinetic energy change as a pendulum swings? Write your hypothesis in the Data and Observations section.

Strategy

You will construct a pendulum.

You will explain how a pendulum behaves.

You will describe the potential energy and kinetic energy of a pendulum.

Materials

ring

strings, 20 cm and 30 cm long (2)

ring stand

sinkers, different sizes (2)

metric ruler

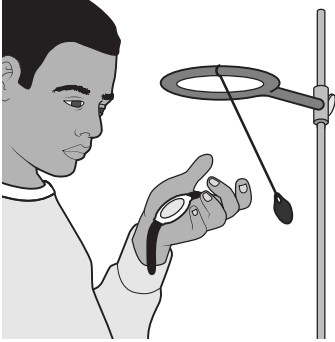
watch with second hand

Laboratory Activity 1 (continued)

Procedure

1. Set up the ring and ring stand. Use the metric ruler to adjust the ring to a height of 35 cm above the table or desk.

Figure 4



2. Securely tie the short string to the smaller sinker. Measure 15 cm along the string. Tie the string at this point to the ring as shown in Figure 4.
3. Allow the pendulum to hang at rest. Consider the energy of the pendulum—potential, kinetic, or both. Record your observations in the Data and Observations section.
4. Hold the pendulum above the table to form a small angle with the ring stand. Record your observations about the pendulum's energy in the Data and Observations section.
5. From the raised position, release the pendulum and allow it to swing for exactly two minutes. Count the number of full swings (back and forth) during the two minutes. Record this information in the Data and Observations section.
6. Run a second trial, counting the swings for another two minutes. Record this information in the data table.
7. Do three other sets of trials: Vary either the length of the string or the size of the sinker as indicated in the data table. Record your information in the data table.
8. Calculate the average number of swings for each two-minute trial. Record this information in the data table.

Data and Observations

Hypothesis:

Step 3 observations:

Laboratory Activity 1 (continued)

Step 4 observations:

Step 5 observations:

Pendulum		Similarities and Differences		
String Length (cm)	Trial 1	Trial 1	Trial 2	Average
15	small			
15	large			
25	small			
25	large			

Questions and Conclusions

- What type of energy does the pendulum have when it is hanging straight down?

- What type of energy does the pendulum have if it is held at a right angle to the stand?

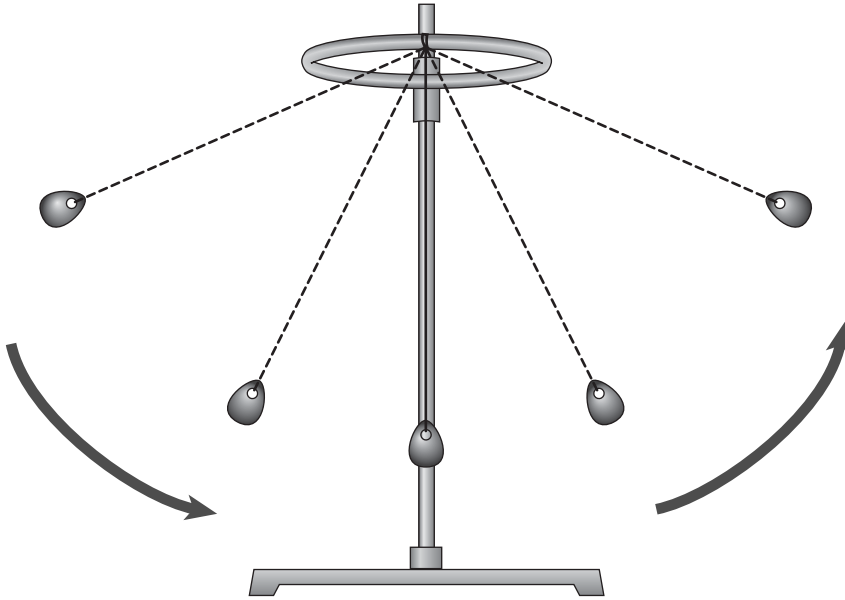
- What force acted on the pendulum when it was released from its raised position?

- Which string length caused the pendulum to swing more times in your trials? Which sinker size caused the pendulum to swing more times?

- How would you best increase the number of swings of a pendulum during a set time period?

Laboratory Activity 1 (continued)

6. Figure 5 represents a pendulum in motion. Look at the diagram and label it as indicated.
- Write the letter P at the positions of maximum **potential** energy.
 - Write the letter K at the position of maximum **kinetic** energy.
 - Write the letter I at the position where kinetic energy is **increased**.
 - Write the letter D at the position where kinetic energy is **decreased**.

Figure 5**Strategy Check**

- _____ Can you explain how a pendulum behaves?
- _____ Can you describe the potential energy of a pendulum?
- _____ Can you describe the kinetic energy of a pendulum?

LAB
2 Laboratory
 Activity

Causing Friction

When you kick a soccer ball along the ground, you know that the ball will eventually roll to a stop when you stop kicking. What happens to the kinetic energy of the ball as it slows down? The law of conservation of energy states that energy cannot be created or destroyed. Therefore, the kinetic energy of the soccer ball does not disappear; it changes form. As the ball rolls over the ground, friction causes some of its kinetic energy to change into thermal (heat) energy, causing the ball to slow down and eventually stop. In this experiment, you will examine how different types of surfaces affect the amount of friction produced.

Strategy

You will predict what types of surfaces produce the least friction.
 You will observe how friction affects the kinetic energy of a toy car.

Materials

books (2)	coarse sandpaper (3 sheets)
meterstick	strip of rough carpeting
toy car	pillowcase
masking tape	

Procedure

- Place a book on top of a smooth, hard surface (such as a table or an uncarpeted floor). Lean a second book against the first to form a ramp. See figure 1.
- Place the car at the top of the ramp and release it. Measure the distance between the bottom of the ramp and the spot where the car stopped moving. Record this distance in the table in the Data and Observations section. Repeat this step two more times, using the meterstick to make sure that you release the car from the same height each time.
- Tape the pieces of sandpaper together to form a strip. Place the strip at the bottom of your ramp. See Figure 2. Repeat Step 4.

Figure 1

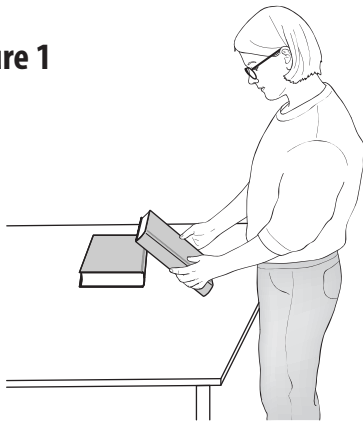
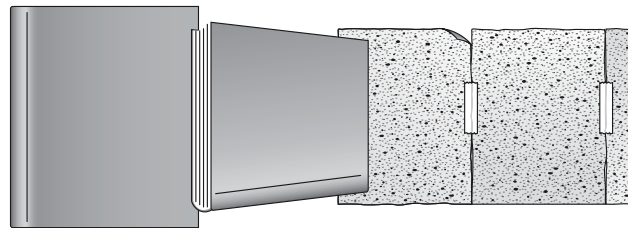


Figure 2



- Use the meterstick to measure the height of the ramp. Record the height in the Data and Observations section.
- Which do you think will reduce the kinetic energy of a toy car more quickly: hard surfaces or soft surfaces? Rough surfaces or smooth surfaces? Record your predictions in the Data and Observations section.

Laboratory Activity 2 (continued)

- Brush ridges into the carpet's surface with your fingers. Remove the sandpaper from the bottom of the ramp and replace it with the carpeting. Repeat Step 4.
- Fold the pillowcase lengthwise into thirds. Place it on top of the carpeting at the bottom of the ramp. Smooth out any wrinkles in the fabric with your hands. Repeat Step 4.
- Calculate the average distance the car traveled on each surface. Record your calculations in the data table.

Data and Observations

Height of ramp: _____

Predict what type of surfaces—hard or soft, smooth or rough—will reduce the kinetic energy of the car the quickest.

Surface	Distance Moved by Car (cm)			Average Distance Moved by Car (cm)
	Trial 1	Trial 2	Trial 3	
Floor or table (hard, smooth)				
Sandpaper (hard, rough)				
Carpet (soft, rough)				
Pillowcase (soft, smooth)				

Questions and Conclusions

- What type of surface (hard or soft, smooth or rough) provided the greatest amount of friction? Explain how you came to this conclusion.

- What type of surface provided the least amount of friction?

Laboratory Activity 2 (continued)

3. What happened to the kinetic energy of the car after it left the ramp?

4. Why was it important that the ramp be the same height in each trial?

5. Describe how you could determine the gravitational potential energy of the car at the top of the ramp.

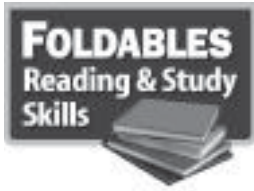
6. Examine the data in your table. Then predict the distance the car would move if you placed a layer of gravel at the bottom of your ramp. Explain how the data helped you make your prediction.

7. Predict whether a hockey puck would move a greater distance over smooth ice or rough ice. Explain how you used the data in your table to make your prediction.

Strategy Check

_____ Can you predict what types of surfaces will produce the least friction?

_____ Can you observe how friction affects kinetic energy?



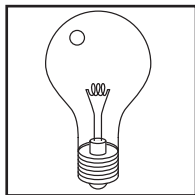
Energy

Directions: Use this page to label your Foldable at the beginning of the chapter.

Know

Want

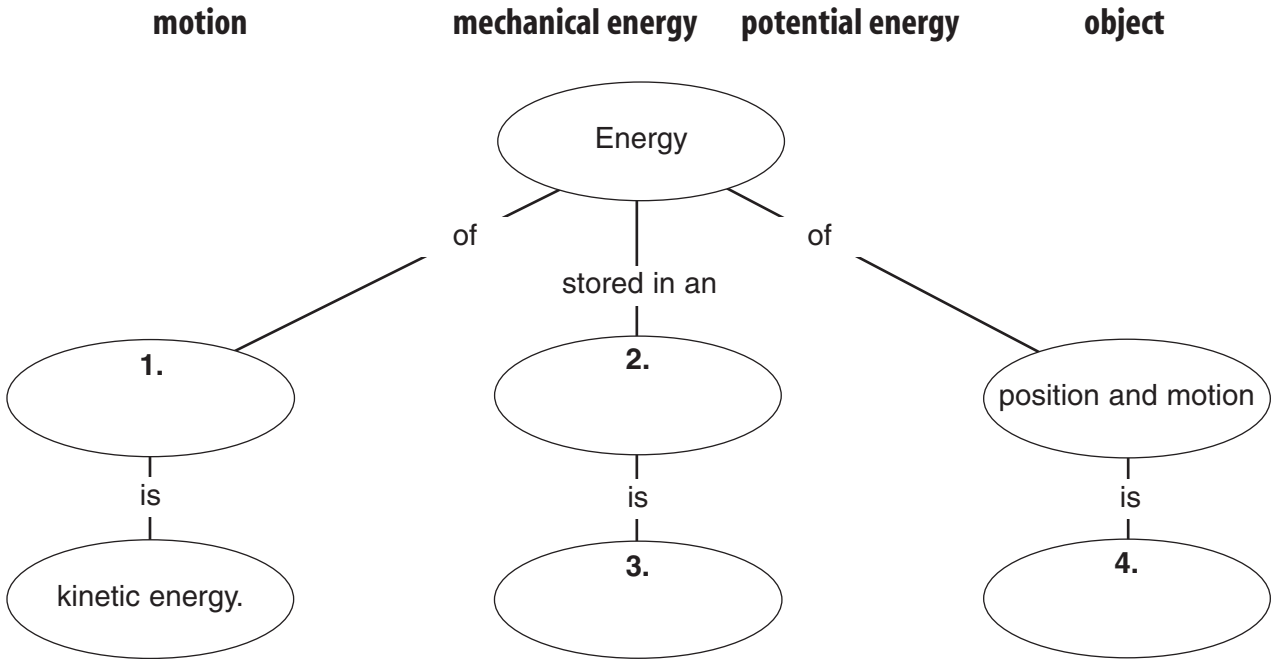
Learned



Meeting Individual Needs

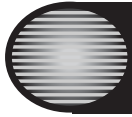


Directions: Complete the concept map using the terms in the list below.



Directions: Three forms of potential energy are gravitational, chemical, and elastic. Write the correct form in the spaces beside the items below. Note that one item has two forms of potential energy.

- _____ 5. chocolate chip cookie
- _____ 6. pogo stick on impact
- _____ 7. gasoline
- _____ 8. bicycle at the top of a hill
- _____ 9. stretched rubber band
- _____ 10. apple in a tree



Directed Reading for
Content Mastery

Section 1 ■ The Nature of Energy

Directions: Draw a line from each type of energy on the left to its example on the right.

- | | |
|-----------------------------------|---|
| 1. kinetic energy | energy that is stored |
| 2. chemical potential energy | energy stored in a stretched spring |
| 3. gravitational potential energy | energy of a spinning bicycle wheel |
| 4. elastic potential energy | energy stored in food |
| 5. potential energy | energy stored in a boulder on a mountaintop |

Directions: Use these words to fill in the blanks below. Words may be used more than once.

energy

more

less

potential

kinetic

joule

chemical

- Two baseballs have the same mass. The ball that is closer to the ground has _____ gravitational potential energy than the other ball.
- Two trucks have the same velocity but different mass. The truck with the greater mass has _____ kinetic energy than the other truck.
- _____ is the ability to cause change.
- A _____ is a unit of measure for all forms of energy.
- When an object falls, some of its _____ energy changes to _____ energy.
- The _____ energy of an object depends on its mass and weight.
- The energy of food and other fuels is _____ potential energy.



Directed Reading for
Content Mastery

Key Terms Energy

Directions: *Unscramble the italicized terms in the sentences below. Write the terms on the lines. Then find the terms in the word search puzzle below.*

- _____ 1. The stored energy an object has as a result of its height above the ground is *aaagiilnrottv* potential energy.
- _____ 2. The law of *aceinnoorstv* of energy states that the total amount of energy in the universe remains the same.
- _____ 3. Energy is measured in SI units called *ejlosu*.
- _____ 4. The energy stored in the bonds between atoms is *accehilm* potential energy.
- _____ 5. The stored energy an object has as a result of its position is *aeilnoptt* energy.
- _____ 6. Energy in the form of motion is *ceiiknt* energy.
- _____ 7. An object's *aaccehilmn* energy is its total amount of potential and kinetic energy.
- _____ 8. The energy stored in stretched or compressed objects is *aceilst* potential energy.

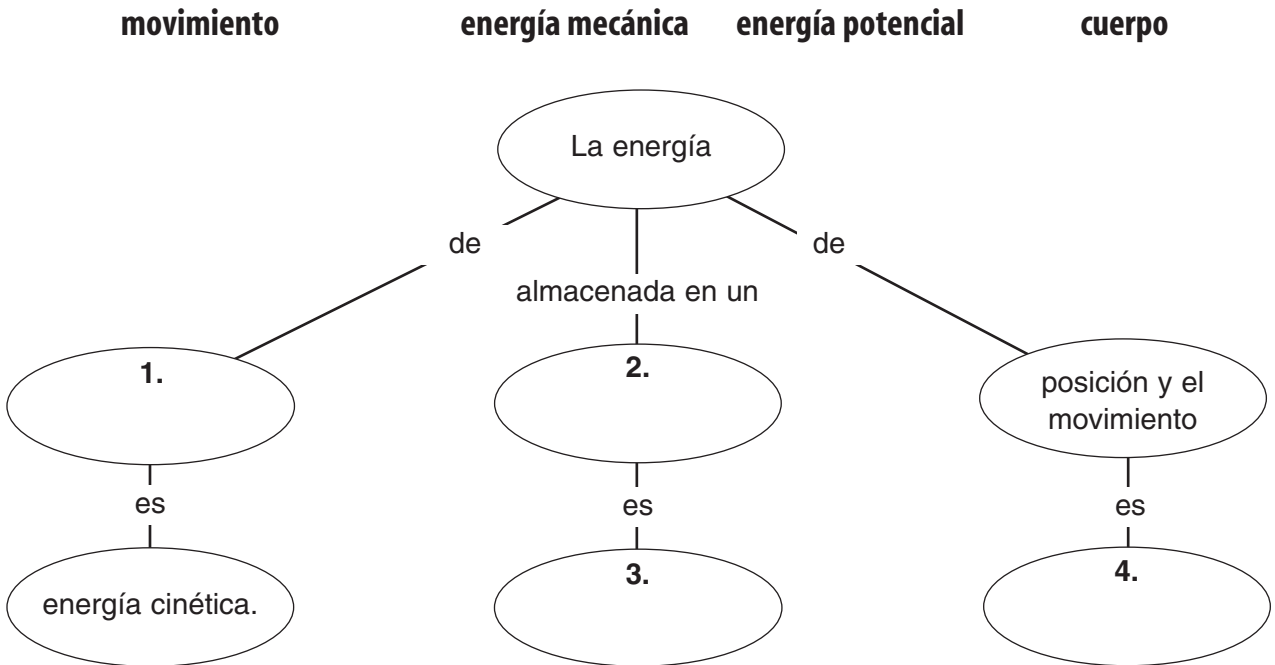
A G T C S E C H E M I C A L E M I Y H
P O T E N T I A L S U T F N O Z I J O
B X U A V F G R A V I T A T I O N A L
L D K N W O V C S R J U L T D P W J K
Y C I L M K K O T B O R M W L V X P Y
E D N E R X N B I I U Q X D P G L H U
Z M E C H A N I C A L V N C H K G Q J
J F T Q P K P W J O E Y G B S D M I R
G F I L B C A C O N S E R V A T I O N
I A C H E M F I E A Z I Z A N O S H Q



Lectura dirigida para
Dominio del contenido

Sinopsis Energía

Instrucciones: Completa el mapa conceptual usando los términos de la siguiente lista.



Instrucciones: Tres formas de energía potencial son la energía gravitatoria, la química y la elástica. Escribe la forma correcta en el espacio. Observa que un cuerpo posee dos formas de energía potencial.

- _____ 5. galleta de chispas de chocolate
- _____ 6. vara pogo al impactar
- _____ 7. gasolina
- _____ 8. bicicleta en la cima de una colina
- _____ 9. liga estirada
- _____ 10. manzana en un árbol



Lectura dirigida para
Dominio del contenido

Sección 1 ■ La naturaleza de la energía

Instrucciones: Conecta cada tipo de energía en el lado izquierdo con el ejemplo correcto a la derecha.

- | | |
|-----------------------------------|--|
| 1. energía cinética | energía almacenada |
| 2. energía química potencial | energía almacenada en un resorte estirado |
| 3. energía gravitatoria potencial | energía de una rueda de bicicleta que gira |
| 4. energía elástica potencial | energía almacenada en los alimentos |
| 5. energía potencial | energía almacenada en una roca en la tapa de una montaña |

Instrucciones: Usa estas palabras para completar las siguientes oraciones. Puedes usar las palabras más de una vez.

energía	más	menos	potencial
cinética	julio		química

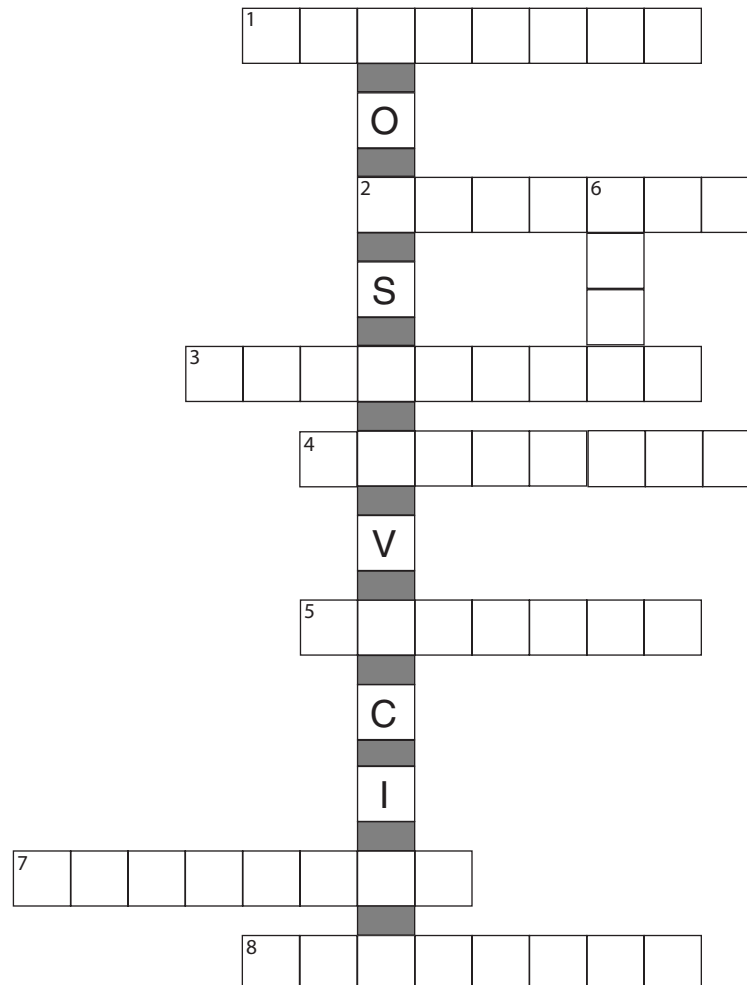
- Dos pelotas de béisbol tienen la misma masa. La pelota que está más cerca del suelo tiene _____ energía gravitatoria potencial que la otra pelota.
- Dos camiones viajan a la misma velocidad pero tienen diferente masa. El camión que tienen más masa tiene _____ energía cinética que el otro camión.
- _____ es la capacidad de causar cambio.
- Un(a) _____ es una unidad de medida para todas las formas de energía.
- Cuando un cuerpo cae, parte de su energía _____ se convierte en energía _____.
- La energía _____ de un cuerpo depende de su masa y de su peso.
- La energía del alimento y otros combustibles es energía _____ potencial.



Lectura dirigida para
Dominio del contenido

Sección 2 ■ Conservación de la Energía

Instrucciones: Escribe en cada línea numerada el término que corresponde a la descripción que se da abajo. Las letras en la caja vertical oscura deben deletrear la respuesta de la pregunta 9.



1. Tipo de energía que resulta de la posición y del movimiento de un cuerpo.
2. Tipo de reacción en la cual la masa se transforma en energía.
3. Tipo de energía que se transforma en energía térmica en un tostador.
4. Fuerza que se produce cuando frotas dos palillos.
5. Unidad que se usa para medir la cantidad de energía que obtenemos de los alimentos.
6. Tipo de energía que las plantas transforman en energía química.
7. Tipo de energía que es mayor en la parte superior de la trayectoria de un péndulo.
8. Tipo de energía que es mayor en la parte inferior de la trayectoria de un péndulo.
9. Ley de la energía que no se ha roto nunca _____.



Lectura dirigida para
Dominio del contenido

Términos claves

Energía

Instrucciones: Descifra el término en *itálicas* para completar las siguientes oraciones. Escribe los términos en la línea en blanco y luego encuétralos en la sopa de letras.

- _____ 1. Energía almacenada en un cuerpo como resultado de su altitud sobre el nivel del mar y su energía potencial *tacoingaarv*.
- _____ 2. La ley de *noicsórcenva* de la energía establece que la cantidad normal de energía del universo permanece igual.
- _____ 3. La energía se mide con una unidad SI llamada *ejlosu*.
- _____ 4. La energía almacenada en los enlaces entre átomos se llama energía potencial *iímqauc*.
- _____ 5. La energía almacenada que un cuerpo tiene como resultado de su posición es energía *ticalonpe*.
- _____ 6. La energía en forma de movimiento es energía *tacicnié*.
- _____ 7. La energía *cáencami* de un cuerpo es la suma de su energía potencial y cinética.
- _____ 8. La energía almacenada en un resorte estirado o comprimido es energía potencial *leáscati*.

A G T C S E M E C Á N I C A E M I Y H
 C O N S E R V A P I O N F N P Z I J O
 B X E A V F G R A V I T A T O R I A M
 L D L N W O V C S R J U L T T P W J K
 Y C Á L M K K O T B U R M W E V X J Y
 E D S E R X N B I I L Q X D N G L U U
 Z P T C H C I N E Q U Í M I C A G L J
 J C I N É T I C A O O Y G B I D M I R
 G F C L B C A C O N S E R V A C I Ó N
 I A A H E M F I E A Z I Z A L O S H Q

SECTION
1

Reinforcement

The Nature of Energy

Directions: Place a plus (+) to the left of the statements that agree with the textbook. Place a minus (-) to the left of the statements that do not agree with the textbook. Circle the word or words that need to be changed, and change the statement so that it is true.

- _____ 1. Anything that causes change must have energy. _____
- _____ 2. Kinetic energy is energy in the form of motion. _____
- _____ 3. The joule is the SI unit of energy. _____
- _____ 4. According to the law of conservation of energy, energy can be created or destroyed.

- _____ 5. Energy may change from one form to another, but the total amount of energy never changes.

- _____ 6. Mechanical energy is the total amount of potential and kinetic energy in a system.

- _____ 7. A rock at the edge of a 200-m high cliff has more potential energy than an equal-sized rock at the edge of a 600-m high cliff.

- _____ 8. The energy stored in foods and fuels is chemical potential energy.

Directions: The chart below compares kinetic energy and gravitational potential energy. Fill in the missing information.

Characteristic	Kinetic Energy	Gravitational Potential Energy
Definition	9.	10.
Units of measure	11.	12.
Quantities in calculation	13.	14.

SECTION
2**Reinforcement****Conservation of Energy**

Directions: *In each of the following situations, energy changes form. Study each situation and identify the energy transformations in the spaces provided.*

1. An electric blanket warms a bed on a chilly night.

2. A rock in Death Valley, California, becomes hot during a summer afternoon.

3. A deputy sheriff rides a horse while directing traffic.

4. A chandelier brightens a ballroom after a waiter moves a switch.

5. A swallow sitting on a fence sings a song for anyone who will listen.

6. A jet plane rapidly accelerates on the runway.

7. A walnut falls to the ground from a high tree branch.

8. A placekicker sends a football through the uprights of a goalpost.

9. A base runner slides safely into third base.

10. A nuclear powered submarine transports its crew from New Orleans to Mobile.

SECTION 1

Enrichment

Transferring Kinetic and Potential Energy

In this activity you will build twin pendulums to observe how kinetic and potential energy can be transferred within a system.

Materials

washers or bolts identically sized (2)
ring stands (2)
strong thread

Procedure

1. Try to duplicate the apparatus shown in the figure. To build twin pendulums, place the two ring stands about 30 cm apart. Tie a piece of thread about one-fourth of the way down from the top of one ring stand. Attach the other end of the thread an equal distance from the top of the other ring stand. There should not be any slack in the thread.
2. Cut two 15-cm lengths of thread. Attach a washer to each thread. Tie the other ends of these threads to the horizontal thread, about 5-cm apart. The washers must hang at exactly the same height.

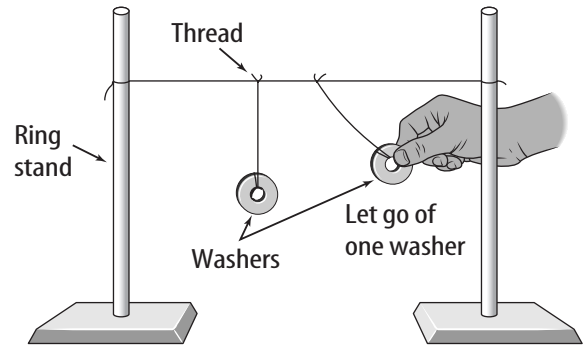


Figure 1

3. Pull one of the washers toward you until it is as high as the horizontal string. Release the washer and observe what happens.

Conclude and Apply

1. Describe what happened to the two pendulums after you released the washer.

2. Explain why the second pendulum was able to move without your touching it.

3. Why did the pendulums eventually stop swinging?

SECTION

2

Enrichment

Conservation of Energy in the Heart

It is important to eat good food for energy and health. The human body changes some of the energy from food into electrical energy, which is used by the nervous system (including the brain). The electrical signals in the body travel through the nerves to every muscle in the body, telling the muscles to move.

The Heart

One of the strongest muscles in the body is the heart. The heart has four sections, or chambers. Each chamber holds blood until the muscles around the opening contract, pumping the blood into the next chamber or out into the arteries and the rest of the body. The signal for the muscles to squeeze comes from the brain. The brain's signal to the heart is electrical.

Conservation of Energy

The brain is always sending signals to the heart. If it didn't, the heart would stop. But where does this electrical energy go after it signals the heart to pump? The law of conservation of energy says that the energy is not lost. Remember that the electrical energy makes the muscles around the chambers of the heart contract, or squeeze together. When the mus-

cles contract, the electrical energy becomes mechanical energy.

Heat

Then, the energy is transformed again. This time it becomes heat. When the heart muscles contract, some of the energy used becomes heat energy. Have you ever been cold and shivered? Shivering is the way muscles in your body use electricity to make heat.

Mechanical Energy

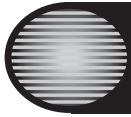
The heart is specially designed to use electrical energy. An area of the heart, called a node, gathers the impulses sent from the brain and sends it to the proper places in the heart. If a node is damaged or stops working, the heart might not be able to use the electrical impulses that the brain sends. Then a special battery-operated device, called a pacemaker, can be placed in the person's body to produce electrical current so that the heart can beat. This energy is used by the heart muscles in the same way as the electrical energy from the brain. It is transformed into mechanical energy and then into heat.

1. What kind of energy does the heart receive from the brain?

2. How is energy conserved in the process of a heartbeat?

3. What is the source of the electrical energy in the brain?

4. While you are alive, does your brain ever stop sending electricity to your heart? Explain your answer.

**Note-taking
Worksheet****Energy****Section 1 The Nature of Energy**

- A. Energy is the ability to cause _____ or do _____.
- Kinetic energy**—energy in the form of _____
 - The amount of kinetic energy an object has depends on its _____ and its _____.
 - Kinetic energy = $\frac{1}{2}$ _____ \times speed²
 - _____—the SI unit used to measure energy
 - Potential energy**—energy stored in a _____ object, giving it the potential to cause change
 - Elastic potential energy**—energy stored by things that _____.
 - Chemical potential energy**—energy stored in _____ between atoms
 - Gravitational potential energy**—energy stored by things that are above _____
 - The GPE of an object depends on its _____, its acceleration due to _____, and its _____.
 - GPE = mass in kilograms \times 9.8 m/s² \times height in _____

Section 2 Conservation of Energy

- A. Energy conversions—energy changing from one _____ to another
- Fuels store energy in the form of _____ energy.
 - _____ **energy**—the total amount of potential and kinetic energy in a system
- B. **Law of conservation of energy**—energy may change from one form to another, but the _____ of energy never changes.
- Example: As a swing moves back and forth, its energy continually converts from _____ to _____ and back.
 - If the energy of the swing decreases, then the energy of some other object must _____ by an equal amount.
 - Friction converts some of the mechanical energy into _____ energy.

Note-taking Worksheet (continued)

C. Converting _____ into energy—you must think of mass as energy when discussing nuclear reactions. The total amount of mass and energy is conserved.

1. Nuclear _____—takes place in the Sun; Two nuclei are fused together.
2. Nuclear fission—Two nuclei are _____.

D. Conservation of energy in your body

1. _____ energy from food is stored in your body and is used to fuel the processes that keep you alive.
2. The food _____ is used to measure how much energy you get from various foods. One Calorie is equivalent to about 4,180J.

Assessment



Chapter Review

Energy

Part A. Vocabulary Review

Directions: Match the description in the first column with the term in the second column by writing the correct letter in the space provided.

- | | |
|---|-----------------------------------|
| _____ 1. total amount of kinetic and potential energy in a system | a. energy |
| _____ 2. the ability to cause change | b. friction |
| _____ 3. stored energy due to position | c. kinetic energy |
| _____ 4. energy in the form of motion | d. law of conservation of energy |
| _____ 5. energy cannot be created or destroyed | e. gravitational potential energy |
| _____ 6. unit used to measure energy in food | f. mechanical energy |
| _____ 7. energy stored in food and fuels | g. potential energy |
| _____ 8. energy stored by things that stretch or compress | h. Calorie |
| _____ 9. energy stored by things that are above earth | i. elastic potential energy |
| _____ 10. SI unit of energy | j. chemical potential energy |
| _____ 11. causes some mechanical energy to change to thermal energy | k. joule |

Part B. Concept Review

Directions: Complete the following sentences using the correct terms.

- _____ 1. The amount of kinetic energy a moving object has depends on its mass and its _____.
- _____ 2. The potential energy of an object depends on its _____.
- _____ 3. The energy stored in foods and fuels is _____ potential energy.
- _____ 4. The law of _____ states that energy cannot be created or destroyed.
- _____ 5. Nutritionists use the _____ to measure how much energy we get from foods.
- _____ 6. The conversion of potential energy to kinetic energy demonstrates the _____.
- _____ 7. You convert kinetic energy into thermal energy when you rub two sticks together because of _____.

Chapter Review (continued)

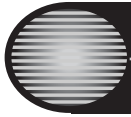
- _____ 8. The total energy of a system remains _____ .
- _____ 9. An orange in a tree has _____ energy due to Earth pulling down on it.
- _____ 10. A car engine changes chemical potential energy into the _____ energy so the car can move.
11. Use the equation $KE = \frac{1}{2}m \times v^2$ to calculate the kinetic energy of a 100-kg cart moving at a speed of 7 m/s.

12. Use the equation $GPE = m \times 9.8 \text{ m/s}^2 \times h$ to calculate the gravitational potential of a 10-kg sack of groceries on a shelf 1 m above the floor.

Directions: Answer the following questions on the lines provided.

13. A hammer falls off a roof and strikes the ground with a certain amount of kinetic energy. If it fell from a roof twice as tall, would its kinetic energy change? Explain.

14. Explain why a streamlined car generally will have better fuel economy than a boxy car with the same mass.



Chapter
Test

Energy

I. Testing Concepts

Directions: Determine whether each of the following statements is true or false. If the statement is true, write **true** in the blank. If the statement is false, replace the italicized term with one that makes the statement true.

- _____ 1. Energy in the form of motion is *potential* energy.
- _____ 2. As the *mass* of a moving object increases, so does its kinetic energy.
- _____ 3. A rock at the edge of a cliff has *kinetic* energy because of its position.
- _____ 4. Friction causes some mechanical energy to change into *thermal* energy.
- _____ 5. Energy that is stored is *kinetic* energy.
- _____ 6. *Mass* is measured in joules.
- _____ 7. Doubling an object's velocity will *double* its kinetic energy.
- _____ 8. *Chemical potential* energy is energy stored in foods and fuels.
- _____ 9. *Thermal* energy is energy stored by things that stretch or compress.
- _____ 10. A book and a feather sitting next to each other on a shelf have *different* potential energies.
- _____ 11. Two copies of the same book are in a book case. One book is twice as high as the other. They have *the same* potential energy.
- _____ 12. A toaster uses *chemical* energy to make toast.
- _____ 13. *Mechanical* energy is the total amount of potential and kinetic energy in a system.
- _____ 14. When a plant falls from a window its *thermal* energy is transformed into kinetic energy.
- _____ 15. The *law of conservation of energy* states that although energy can change forms, it can never be created or destroyed.

Directions: In the blanks, write the letter of the term or phrase that correctly answers each question or best completes each statement.

- _____ 16. Which of the following is not used to calculate kinetic energy?

a. mass	c. height
b. weight	d. speed
- _____ 17. Which of the following is not used to calculate potential energy?

a. mass	c. height
b. gravitational acceleration	d. speed

Chapter Test (continued)

- _____ 18. Thermal energy is measured in _____.
 a. joules b. N c. °C d. j/kg
- _____ 19. The _____ energy of an object increases with its height.
 a. chemical c. thermal
 b. kinetic d. potential
- _____ 20. The kinetic energy of an object increases as its _____ increases.
 a. height above Earth c. potential energy
 b. speed d. volume
- _____ 21. Mechanical energy is the total kinetic and _____ energies in a system.
 a. thermal b. chemical c. potential d. electrical
- _____ 22. _____ can cause kinetic energy to change into thermal energy.
 a. friction b. gravity c. potential energy d. heat
- _____ 23. Green plants convert light energy from the Sun into _____.
 a. gravitational potential energy c. thermal energy
 b. chemical potential energy d. mechanical energy
- _____ 24. The mechanical energy of a coconut falling from a tree _____.
 a. doesn't exist b. increases c. decreases d. remains constant
- _____ 25. The law of _____ states that energy in a system can change forms but can never be created or destroyed.
 a. conversion of energy c. conservation of energy
 b. consecration of energy d. construction of energy

II. Understanding Concepts

Directions: Read the paragraph below. Use the information in the paragraph to answer Questions 1 through 4.

A carpenter lifts a 10-kg piece of wood to his shoulder which is 1.5 m above the ground. He then sets the wood on his truck at 1.0 m above the ground and makes his delivery going 10 m/s.

- a. What is the wood's potential energy on the carpenter's shoulder? _____

b. On the truck? _____
- What is the wood's kinetic energy during the delivery? _____
- If the wood drops from the carpenter's shoulder, what would its maximum kinetic energy be? (Hint: Use the law of conservation of energy.) _____

Chapter Test (continued)

Skill: Comparing and Contrasting

4. Why is the kinetic energy of the lumber higher on the truck during the delivery than when it drops from the carpenter's shoulder?

Skill: Interpreting Data

Directions: The table below gives the number of Calories used by a person with a medium body frame performing each activity for one hour. Use this information to answer the questions that follow.

Calories Used in One Hour (by a person with a medium body frame)	
Type of Activity	Calories
Sitting	84
Eating	98
Standing	112
Walking	210
Playing tennis	420
Running	850

5. Which listed activity uses the most Calories? _____

6. Which listed activity uses the fewest Calories? _____

7. How many Calories would you use walking for a half hour and running for 15 minutes? Assume the information in the table applies to you.

8. How does the Calorie use for walking compare to the Calorie use for standing?

Chapter Test (continued)**III. Applying Concepts****Writing Skills**

Directions: Answer the following questions in complete sentences on the lines provided.

1. Explain how energy is conserved when you throw a ball into the air and catch it.

2. Explain the role friction plays in the conservation of energy.

3. Most Earth satellites follow an oval path around Earth, rather than a circular path. The potential energy of a satellite increases when the satellite moves farther from Earth. According to the law of conservation of energy, does a satellite travel at its greatest speed when it is closest to or farthest from Earth? Explain.

4. A 200-kg boulder is raised 10 m above the ground and then is dropped. Calculate its kinetic energy just before it hits the ground.

Transparency Activities

SECTION**1****Section Focus
Transparency Activity****They've Got Potential**

Here's a tough question: What do these three pictures have in common?



1. What happens between the top and the bottom of a waterfall?
2. How do moose use moss?
3. What happens as the tennis ball returns to its original shape?

SECTION
2**Section Focus**
Transparency Activity**Power Plants**

All living things have something in common—they need energy to stay alive. Plants convert energy from the Sun into a form of energy that other living things can use.



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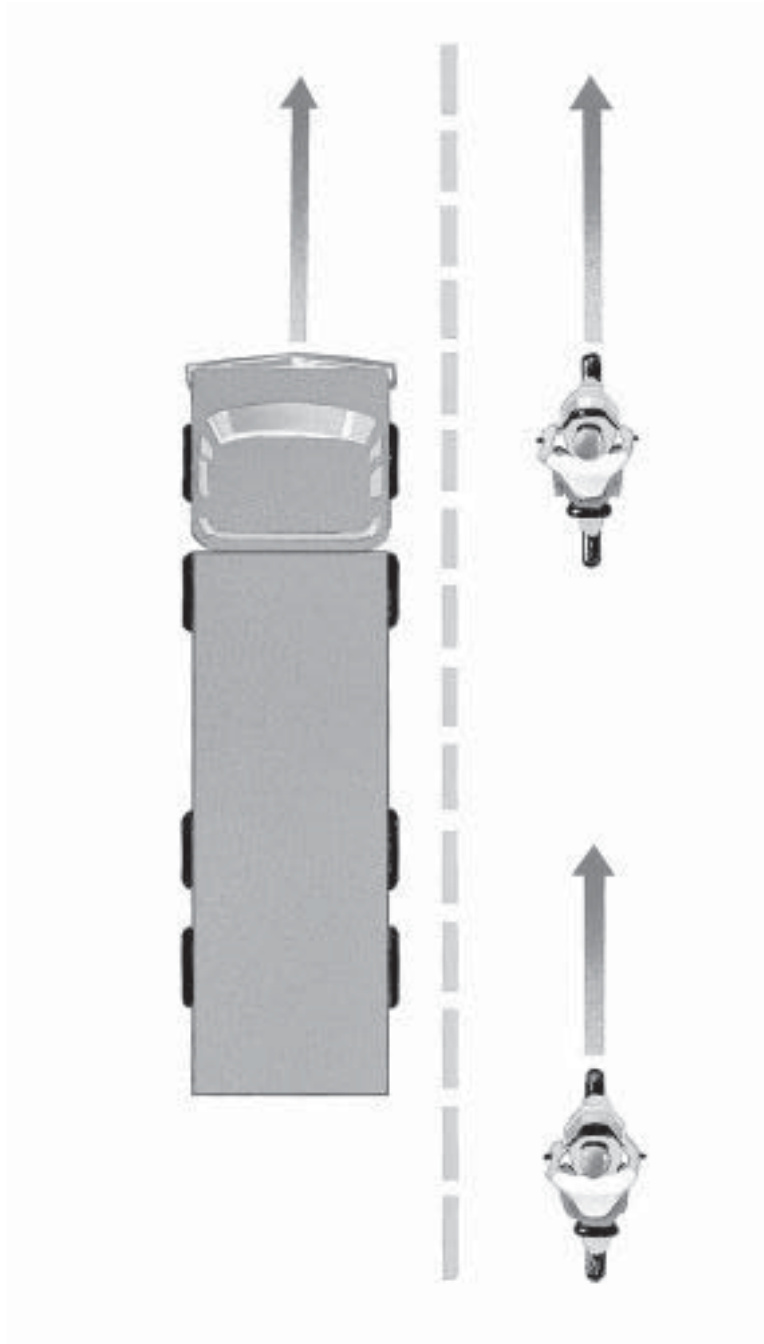
1. How do people obtain energy from plants?
2. Name some other sources of energy that you use.

SECTION

1

**Teaching Transparency
Activity**

Kinetic Energy



Teaching Transparency Activity (continued)

1. What is kinetic energy?

2. What two qualities affect the truck's kinetic energy?

3. Which SI unit is used to measure energy?

4. Which has more kinetic energy—the motorcycle moving at 100 km/h or the truck moving at 100 km/h? Why?

5. If an object's mass is 60 kg and velocity is 100 m/s, how much kinetic energy is present? (Show all of your work. Remember that kinetic energy = $\frac{1}{2}$ mass \times velocity², where mass is given in kilograms and speed in meters per second.)

**Assessment
Transparency Activity****Energy**

Directions: Carefully review the table and answer the following questions.

Person	Calories Consumed	Activity	Length of Activity	Calories Burned
1	400	Watching TV	2 h	150
2	200	Walking	1 h	180
3	1,000	Running	1/2 h	350
4	450	Playing tennis	1 h	460

1. What principle is probably being tested in the above experiment?
A speed
B nuclear fission
C energy conversion
D gravitational potential energy
2. Students conducted an experiment to find which form of exercise burned the most Calories. They placed data from the experiment into the table above. The experiment could be improved by ____.
F having the same person do each activity for the same amount of time
G recording the time of day each activity was performed
H recording the air temperature during each activity
J calculating person 2's rate of speed
3. Which person burned more Calories than consumed?
A person 1
B person 2
C person 3
D person 4

Teacher Support and Planning

Teacher Support and Planning

Content Outline for Teaching	T2
Spanish Resources	T4
Teacher Guide and Answers	T8



Section 1 The Nature of Energy

- A. Energy is the ability to cause change or do work.
1. **Kinetic energy**—energy in the form of motion
 - a. The amount of kinetic energy an object has depends on its mass and its speed.
 - b. Kinetic energy = $\frac{1}{2} \text{mass} \times \text{speed}^2$
 - c. Joule—The SI unit used to measure energy
 2. **Potential energy**—energy stored in a motionless object, giving it the potential to cause change
 3. **Elastic potential energy**—energy stored by things that stretch or compress
 4. **Chemical potential energy**—energy stored in chemical bonds between atoms
 5. **Gravitational potential energy**—energy stored by things that are above Earth .
 - a. The GPE of an object depends on its mass, its acceleration due to gravity, and its height above ground.
 - b. GPE = mass in kilograms \times 9.8 m/s² \times height in meters

DISCUSSION QUESTION:

How does food provide energy for your body? *Chemical potential energy is stored in the chemical bonds between atoms in the food. When you digest food, your body breaks down the molecules in the food, breaking the chemical bonds and releasing energy.*

Section 2 Conservation of Energy

- A. Energy conversions—energy changing from one form to another
1. Fuels store energy in the form of chemical potential energy.
 2. **Mechanical energy**—the total amount of potential and kinetic energy in a system
- B. **Law of conservation of energy**—energy may change from one form to another, but the total amount of energy never changes.
1. Example: As a swing moves back and forth, its energy continually converts from kinetic to potential and back.
 2. If the energy of the swing decreases, then the energy of some other object must increase by an equal amount.
 3. Friction converts some of the mechanical energy into thermal energy.
- C. Converting mass into energy—You must think of mass as energy when discussing nuclear reactions. The total amount of mass and energy is conserved.
1. Nuclear fusion—takes place in the Sun; Two nuclei are fused together.
 2. Nuclear fission—Two nuclei are broken apart.
- D. Conservation of energy in your body
1. Chemical potential energy from food stored in your body is used to fuel the processes that keep you alive.

Content Outline for Teaching (continued)

2. The food Calorie is used to measure how much energy you get from various foods. One Calorie is equivalent to about 4,180 J.

DISCUSSION QUESTION:

Is energy lost when a car burns gasoline? Explain. *No, energy is always conserved. When a car burns gasoline, that energy is changed to kinetic energy which makes the car move. In turn, friction from the tires on the road converts some of that kinetic energy into thermal energy, which remains in the road and the tires.*

**La naturaleza de la energía****Lo que aprenderás**

- A distinguir entre energía cinética y energía potencial.
- A reconocer distintas formas en que se puede almacenar la energía.

Vocabulario

kinetic energy / energía cinética: energía en forma de movimiento; depende de la masa y velocidad del cuerpo.

joule / julio: unidad SI de energía.

potential energy / energía potencial: energía almacenada debido a la posición de los cuerpos; se puede convertir en energía cinética cuando algo actúa para liberarla.

elastic potential energy / energía potencial elástica: energía almacenada por cuerpos que se estiran, tuercen o comprimen.

chemical potential energy / energía potencial química: energía almacenada en enlaces químicos.

gravitational potential energy / energía potencial gravitatoria: energía almacenada por cuerpos que se atraen entre sí debido a la fuerza de gravedad.

Por qué es importante

El entendimiento de la energía te permite entender cómo cambia tu ambiente.

**Pelotas saltarinas**

¿Qué sucede cuando dejas caer una pelota sobre una superficie dura y plana? Empieza con energía potencial. Rebota de arriba a abajo hasta que finalmente cae en reposo. ¿Dónde se fue la energía?

Problema del mundo real

¿Por qué las pelotas paran de rebotar?

Materiales

pelota de tenis
pelota de goma
balanza
vara de medir
cinta adhesiva
caja de cartón o caja de zapatos

Metas

- Identificar las formas de energía que se observan en el rebote de una pelota.
- Inferir por qué la pelota deja de rebotar.

Medidas de seguridad **Procedimiento**

1. Determina la masa de las dos pelotas.
2. Haz que un compañero deje caer una pelota desde 1 metro de altura. Mide la altura del rebote de la pelota. Repite esto otras dos veces de manera que puedas calcular la altura promedio del rebote. Anota tus valores en la tabla de datos.
3. Repite el paso 2 con la otra pelota.
4. Pronostica si las pelotas rebotarán más alto o más bajo si se dejan caer sobre la caja de cartón. Diseña un experimento para medir la altitud del rebote de las pelotas en la superficie de una caja de cartón.

Registro de altura de rebote			
Tipo de Pelota	Superficie	Prueba	Altura (cm)
Tenis			
Tenis			
Tenis			
Goma			
Goma			
Goma			
Tenis			

Concluye y aplica

1. Calcula la energía potencial de gravedad en cada pelota antes de dejarla caer.
2. Calcula la altura promedio de los rebotes en las tres pruebas que hiciste para cada condición. Describe tus observaciones.
3. Compara la altura de los rebotes de las pelotas que rebotaste en la caja de cartón con la altura de las pelotas que rebotaste en el piso. Pista: *¿Observaste si la caja se movió cuando las pelotas rebotaron?*
4. Usa el concepto de energía potencial elástica para explicar el por qué las pelotas rebotaron a diferentes alturas.



Conservación de la energía

Lo que aprenderás

- Describir cómo se conserva la energía al cambiar de una forma a otra.
- Aplicar la ley de conservación de la energía a situaciones familiares.

Vocabulario

mechanical energy / energía mecánica: suma de la energía potencial y la cinética de un sistema.

law of conservation of energy / ley de conservación de la energía: establece que la energía no se crea ni se destruye.

Por qué es importante

La conservación de la energía es un principio universal que puede explicar cómo ocurren los cambios de energía.



Diseña tu propio experimento

Energía oscilatoria

Imagina que te meces en un columpio. ¿Qué sucedería si un amigo agarra las cadenas del columpio cuando pasa por el punto más bajo? ¿Llegarías a detenerte completamente, o continuarías ascendiendo a tu altura máxima anterior?

Problema del mundo real

¿Cómo diseñarías un experimento para contestar las preguntas de la situación que se describió arriba?

Formula una hipótesis

Examina el aparato de la página de tu texto. ¿En qué se parece a la situación del párrafo introductorio? ¿Qué les pasará al movimiento y a la altura final del péndulo si su oscilación se interrumpe? Formula una hipótesis.

Metas

- Construye un péndulo para comparar el intercambio de energía potencial y cinética cuando se interrumpe una oscilación.
- Mide las alturas inicial y final del péndulo.
- Usa la ley de conservación de la energía para explicar las observaciones.

Spanish Resources (continued)

materiales posibles

soporte y aro de metal
 abrazadera para varilla de soporte, ángulo recto
 varilla de soporte de 30 cm
 tapón de goma mediano, con 2 agujeros
 cordón (1 m)
 varas de medir
 papel cuadriculado
 libro de texto

Medidas de seguridad



Asegúrate de que la base sea lo suficientemente pesada o esté bien anclada, de manera que el aparato no se vuelque.

Prueba tu hipótesis

Haz un diseño

1. En grupo, formula tu hipótesis y enumera los pasos que tomarás para probarla. Debes ser específico. También enumera los materiales que requerirás.
2. Diseña una tabla de datos.
3. Monta un aparato similar al que se muestra en el diagrama del libro de texto.
4. Inventa un método para medir las alturas inicial y final del péndulo. Anota tu altura inicial y la final en una tabla de datos.
5. Decide cómo liberarás el tapón, cada vez desde la misma altura.
6. Asegúrate de probar tu oscilación, iniciándola por arriba y por debajo de la altura del brazo transversal. ¿Cuántas veces deberías repetir cada punto inicial?

Sigue tu diseño

1. Asegúrate de que tu maestro(a) apruebe tu plan antes de empezar.
2. Realiza el experimento aprobado de acuerdo con lo planificado.
3. Mientras el experimento se desarrolla, escribe cualquier observación que hagas y completa la tabla de datos.

Analiza tus datos

1. Cuando el tapón se libera a la misma altura del brazo transversal, ¿es la altura final del tapón exactamente igual a su altura inicial? Usa tus datos para apoyar tu respuesta.
2. Analiza las transferencias de energía. ¿En qué punto, a lo largo de una sola oscilación, tiene el tapón la mayor energía cinética? ¿La mayor energía potencial?

Concluye y aplica

1. Explica. Apoyan tu hipótesis los resultados?
2. Compara las alturas inicial y final del tapón. ¿Puedes justificar la conducta observada?
3. Discuta. Apoyan la ley de conservación de la energía tus resultados? Por qué?
4. Infiere. ¿Qué sucede si se aumenta la masa del tapón? Haz la prueba.

Guía de estudio

Repasa las ideas principales

Refiérete a las figuras en tu libro de texto.

Sección 1 La naturaleza de la energía

1. La energía es la capacidad de un objeto de causar cambio.
2. La energía puede tomar una variedad de formas.
3. Los cuerpos en movimiento tienen energía cinética que depende de la masa y velocidad del cuerpo.
4. La energía potencial es energía almacenada. Los cuerpos que pueden caer tienen energía potencial gravitatoria—la cantidad depende del peso y altura sobre la tierra.

Spanish Resources (continued)

Sección 2 Conservación de la energía

1. La energía puede cambiar de una forma a otra. Observas muchas transformaciones de energía a diario.
2. La ley de conservación de la energía establece que la energía nunca puede crearse o destruirse. Debido a la fricción, la energía puede parecer que se pierde, pero cambia a energía térmica.
3. Todos los cuerpos que caen, vuelan u oscilan involucran transformaciones entre la energía potencial y la cinética. *¿Qué transformaciones de energía se están manifestando en la figura? ¿Se está conservando la energía?*
4. La masa puede convertirse en energía en la fusión nuclear y en las reacciones de fisión. La fusión y la fisión involucran núcleos atómicos y liberan tremendas cantidades de energía.

Teacher Guide & Answers

Hands-On Activities

MiniLAB (page 3)

1. The farther you stretch the band, the faster the nickel takes off.
2. The greater the speed of the nickel, the greater its kinetic energy.

MiniLAB: Try at Home (page 4)

1. It rose because some of the clip's mechanical energy was converted to thermal energy.
2. Chemical energy from the student's body converted to kinetic energy that transferred to the paper clip. Mechanical energy is then converted to thermal energy because of friction (collisions of the molecules).

Lab (page 5)

Lab Preview

1. Height and gravitational pull (speed) must remain constant to test the variables of ball and surface types.
2. The cardboard box provides a second surface for the bouncing balls.

Conclude and Apply

1. Use the formula: $GPE = m \text{ (kg)} \times 9.8 \text{ m/s}^2 \times h \text{ (m)}$.
2. Average height = sum of heights ÷ number of trials. Answers will vary.
3. The balls do not bounce as high on the box because some of the kinetic energy transferred to the box, causing the box to vibrate. This energy is then unavailable to help propel the ball upward.
4. When a ball hits the ground, most of its kinetic energy is converted to elastic potential energy. This becomes kinetic energy as the ball rebounds. Some balls store more elastic potential energy than others.

Lab: Design Your Own (page 7)

Lab Preview

1. A rubber stopper has more mass than a cork stopper. Most of the mass of the pendulum would then be concentrated in the bob.
2. Energy is neither created or destroyed.

Analyze Your Data

1. no
2. Kinetic is greatest at the bottom; potential is greatest at the top.

Conclude and Apply

1. Answers will vary with results.
2. Ending heights are lower. Friction slows the stopper and removes some energy from the system.
3. Yes; the apparent loss of energy is due to friction.

4. Kinetic and potential energy increase; the person must pull harder to stop the swing.

Laboratory Activity 1 (page 9)

Note: Instruct students to make sure the string is stretched tight before they release the pendulum.

Lab Note: The pendulum itself hanging at rest has no kinetic or potential energy. On Earth, the pendulum has potential energy (due to gravity) because it could fall. At the atomic level, potential and kinetic energy exist because of forces and motions among and within atoms.

Data and Observations

Hypothesis: Accept all reasonable hypotheses.

Step 3: The pendulum has no kinetic or potential energy with respect to the apparatus. It does have potential energy with respect to Earth.

Step 4: The pendulum now has potential energy, with respect to the apparatus.

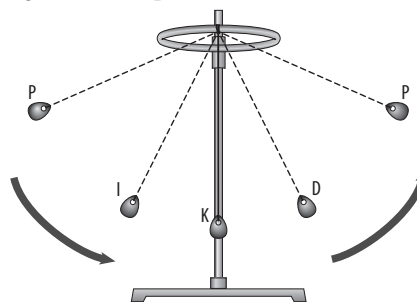
Step 5: Student data will vary depending on length of string.

Table 1

Student data will vary. The longer strings should show fewer swings than the shorter strings.

Questions and Conclusions

1. When the pendulum is hanging straight down, it has no potential energy or kinetic energy with respect to the apparatus. It does have potential energy with respect to Earth.
2. The pendulum has potential energy when it is held at a right angle to the stand.
3. The force of gravity.
4. The shorter string should produce more swings than the longer string. However, both sinkers should cause the pendulum to behave the same.
5. Use shorter strings to increase the number of swings in a time period.
- 6.



Laboratory Activity 2 (page 13)

Note: There are different grades of sandpaper. This will work best with one of the roughest grades.

Data and Observations

Height of ramp: Data will vary with the books chosen. The height should be expressed in centimeters.

Types of surfaces: Accept any reasonable prediction.

Table: Students' data will vary. In general, soft, rough

surfaces will reduce the kinetic energy quicker than hard smooth surfaces will.

Questions and Conclusions

- Soft, rough surfaces provided the greatest friction. The car traveled a shorter distance on these surfaces.
- Smooth hard surfaces provided the least amount of friction.
- Friction changed the kinetic energy into thermal energy.
- A constant ramp height makes everything associated with the ramp constant. This allows the distance traveled to be compared.
- To calculate the gravitational potential energy of the car at the top of the ramp, determine the mass of the car and the height of the ramp. Then, use the formula: $GPE (J) = m (kg) \times 9.8 \text{ m/s}^2 \times h (m)$.
- Accept any reasonable prediction. The prediction should show an understanding of the role friction plays in transforming kinetic energy into thermal energy.
- Students should understand that the smooth ice provides less friction than rough ice and that the hockey puck will travel farther on the smooth ice.

Meeting Individual Needs

Directed Reading for Content Mastery (page 19)

Overview

- motion
- object
- potential energy
- mechanical energy
- chemical
- elastic
- chemical
- gravitational
- elastic
- gravitational, chemical

Section 1 (page 20)

- energy of a spinning bicycle wheel
- energy stored in food
- energy stored in a boulder perched on a mountaintop
- energy stored in a stretched spring
- energy that is stored
- less
- more
- Energy
- joule
- potential, kinetic
- potential
- chemical

Sections 2 (page 21)

- mechanical
- nuclear
- electrical
- friction

- Calorie
- light
- potential
- kinetic
- Law of conservation of energy

Key Terms (page 22)

- gravitational
- conservation
- joules
- chemical
- potential
- kinetic
- mechanical
- elastic

Lectura dirigida para Dominio del contenido (pág. 23)

A	G	T	C	S	E	C	H	E	M	I	C	A	L	E	M	I	Y	H
P	O	T	E	N	T	I	A	L	S	U	T	F	N	O	Z	I	J	O
B	X	U	A	V	F	G	R	A	V	I	T	A	T	I	O	N	A	L
L	D	K	N	W	O	V	C	S	R	J	U	L	T	D	P	W	J	K
Y	C	I	L	M	K	K	O	T	B	O	R	M	W	L	V	X	P	Y
E	D	N	E	R	X	N	B	I	I	U	Q	X	D	P	G	L	H	U
Z	M	E	C	H	A	N	I	C	A	L	V	N	C	H	K	G	Q	J
J	F	T	Q	P	K	P	W	J	O	E	Y	G	B	S	D	M	I	R
G	F	I	L	B	C	A	C	O	N	S	E	R	V	A	T	I	O	N
I	A	C	H	E	M	F	I	E	A	Z	I	Z	A	N	O	S	H	Q

Sinopsis

- movimiento
- cuerpo
- energía potencial
- energía mecánica
- química
- elástica
- química
- gravitatoria
- elástica
- gravitatoria, química

Sección 1 (pág. 24)

- la energía de una rueda de bicicleta que gira
- la energía almacenada en alimentos
- la energía almacenada en una peña suspendida en la ladera de una montaña
- la energía almacenada en un resorte estirado
- energía almacenada
- menos
- más
- Energía
- julio
- potencial, cinética
- potencial
- química

Teacher Guide & Answers (continued)

Sección 2 (pág. 25)

1. mecánica
2. nuclear
3. eléctrica
4. fricción
5. Caloría
6. luz
7. potencial
8. cinética
9. ley de conservación de la energía

Términos claves (pág. 26)

1. gravitatoria
2. conservación
3. julios
4. química
5. potencial
6. cinética
7. mecánica
8. elástica

A	G	T	C	S	E	M	E	C	A	N	I	C	A	E	M	I	Y	H
C	O	N	S	E	R	V	A	P	I	O	N	F	N	P	Z	I	J	O
B	X	E	A	V	F	G	R	A	V	I	T	A	T	O	R	I	A	M
L	D	L	N	W	O	V	C	S	R	J	U	L	T	T	P	W	J	K
Y	C	A	L	M	K	K	O	T	B	U	R	M	W	E	V	X	J	Y
E	D	S	E	R	X	N	B	I	I	L	Q	X	D	N	G	L	U	U
Z	P	T	C	H	C	I	N	E	Q	U	I	M	I	C	A	G	L	J
J	C	I	N	E	T	I	C	A	O	O	Y	G	B	I	D	M	I	R
G	F	C	L	B	C	A	C	O	N	S	E	R	V	A	C	I	O	N
I	A	A	H	E	M	F	I	E	A	Z	I	Z	A	L	O	S	H	Q

Reinforcement (page 27)

Section 1

1. +
2. +
3. +
4. -; change *can* to *cannot*
5. +
6. +
7. -; change *more* to *less*
8. +
9. energy of motion
10. energy stored by things that are above Earth
11. joules
12. joules
13. mass, speed
14. mass, acceleration due to gravity, height above the ground.

Section 2 (page 28)

Note: Students' answers may be more or less complex than those given.

1. Electrical energy changes into thermal energy.
2. Light energy changes into thermal energy.
3. Chemical potential energy changes into kinetic (and thermal) energy for the deputy and the horse.
4. The waiter's chemical potential energy changes

into kinetic energy of motion, and the switch's kinetic energy transformed into electrical energy, which changes into light energy.

5. The swallow's chemical potential energy changes into kinetic energy causing vibrations that result in sound. The sound energy changes into kinetic energy (vibrations) in the listener's eardrum, which changes into electrical energy before reaching the listener's brain.
6. Chemical potential energy changes into thermal energy, which powers the engine. The thermal energy changes to both kinetic and potential energy as the plane takes off.
7. Gravitational potential energy becomes kinetic energy.
8. The placekicker's chemical potential energy changes into mechanical energy in the legs, which changes into kinetic and potential energy in the football.
9. Chemical potential energy transforms into kinetic energy, which changes to thermal energy as a result of friction between the runner and the ground.
10. Chemical potential energy is changed into thermal energy, which is converted to mechanical energy.

Enrichment

Section 1 (page 29)

1. Students' descriptions can vary. Theoretically, the first pendulum falls quickly. It begins to slow down just after it passes the lowest point in the swing and enters the upward part of the swing. When the first pendulum hits the second pendulum, the first pendulum slows further and the second pendulum starts to swing. The two pendulums continue to swing. Each time the two pendulums make contact, some energy is transferred and the swing of each pendulum changes. Both pendulums stop swinging when all of the kinetic energy in the system has dissipated.
2. The energy of the first washer and string (pendulum) was transferred to the second washer and string (pendulum).
3. The mechanical energy changed into thermal energy due to friction.

Section 2 (page 30)

1. electrical
2. The electrical energy from the brain is converted to mechanical energy when the heart muscles contract. Also, some of the mechanical energy changes into heat energy.
3. All of the energy used in the body comes from the food we eat.
4. The brain never stops sending electricity to the heart. If it did, the heart would stop beating and the person would die.

Note-Taking Worksheet (page 31)

Refer to Teacher Outline; student answers are underlined.

Assessment

Chapter Review (page 35)

Part A. Vocabulary Review

- f (4/2)
- a (4/1)
- g (4/1)
- c (4/1)
- d (4/2)
- h (4/2)
- j (4/2)(4/1)
- i (4/2)(4/1)
- e (4/2)(4/1)
- k (4/1)
- b (4/2)

Part B. Concept Review

- velocity (4/1)
- position (4/1)
- chemical (4/1)
- conservation of energy (4/2)
- calorie (4/2)
- law of conservation of energy (4/2)
- friction (4/2)
- constant (4/2)
- gravitational potential (4/1)
- kinetic (4/1)
- 2,450 J (4/1)
- 98 J (4/1)
- Because the potential energy of the hammer doubles when its height above ground doubles, the kinetic energy of the hammer at impact also doubles. This assumes that there is no energy changed to thermal energy due to friction with the air. (4/1)
- Friction causes some kinetic energy to be transformed into thermal energy, which reduces engine efficiency. Streamlining reduces friction. (4/2)

Chapter Test (page 37)

I. Testing Concepts

- false; kinetic (4/1)
- true (4/1)
- false; potential (4/1)
- true (4/2)
- false; potential (4/1)
- false; energy (4/1)
- false; quadruple (4/1)
- true (4/1)
- false; elastic potential (4/1)
- true (4/1)
- false; different (4/1)

- false; electrical (4/2)
- true (4/2)
- false; potential (4/1)
- true (4/2)
- c (4/1)
- d (4/1)
- a (4/2)
- d (4/1)
- b (4/1)
- c (4/2)
- a (4/2)
- b (4/1)
- d (4/2)
- c (4/2)

II. Understanding Concepts

- $GPE = \text{mass} \times 9.8 \text{ m/s}^2 \times \text{height}$
 $= 10 \text{ kg} \times 9.8 \text{ m/s}^2 \times 1.5 \text{ m}$
 $= 147 \text{ J}$ (4/1)
 - $GPE = \text{mass} \times 9.8 \text{ m/s}^2 \times \text{height}$
 $= 10 \text{ kg} \times 98 \text{ m/s}^2 \times \text{height}$
 $= 98 \text{ J}$ (4/1)
- $KE = 1/2 \text{ mass} \times \text{velocity}^2$
 $= 1/2 \times 10 \text{ kg} \times (10 \text{ m/s})^2$
 $= 500 \text{ J}$ (4/1)
- The maximum kinetic energy would equal the wood's gravitational potential energy on the carpenter's shoulder, or 147 J. (4/1)
- The truck's speed is greater than the wood's as it drops. That difference is then squared. (4/1)
- running (4/2)
- sitting (4/2)
- 317.5 Calories (4/2)
- Walking uses about twice as many Calories as standing. (4/2)

III. Applying Concepts

- Energy remains constant within the system. When the ball leaves your hand, it has maximum kinetic energy and minimum potential energy. As the ball rises, its kinetic energy decreases while its potential energy increases by the same amount. At its highest point, the ball has no kinetic energy and has its greatest potential energy. At any point during the throw, the mechanical energy equals the sum of the potential energy and kinetic energy. (4/1)
- The law of the conservation of energy states that energy cannot be created or destroyed. Friction changes some of the mechanical energy of an object into thermal energy. The total energy of a system—potential and kinetic plus any converted energy—remains constant. (4/2)
- Because mechanical energy remains constant, the kinetic energy of the satellite is greatest close to Earth, where its potential energy is least. Because kinetic energy depends on mass and velocity, velocity would be at its maximum close to Earth as long as the satellite's mass remains constant. (4/2)

Teacher Guide & Answers (continued)

$$\begin{aligned} 4. \quad PE &= \text{mass} \times 9.8 \text{ m/s}^2 \times \text{height} \\ &= 200 \text{ kg} \times 9.8 \text{ m/s}^2 \times 10 \text{ m} \\ &= 19,600 \text{ J (4/1)} \end{aligned}$$

Section Focus Transparency 1 (page 42)

They've Got Potential

Transparency Teaching Tips

- This transparency introduces potential, or stored, energy, the common thread through the three pictures. Ask students to describe how energy relates to each of the pictures. Explain that there are different forms of potential energy. The tennis ball on the racket represents elastic potential energy, the waterfall illustrates gravitational potential energy, and the moose consuming food depicts chemical potential energy.
- Ask students to volunteer other examples of potential energy.

Content Background

- The scientific definition of work is force exerted over distance. The capacity to perform work is called energy.
- In the International System of Measurements (SI), the unit of work is the joule. A joule is equal to the work done by a force of one newton over a distance of one meter. In the English system of measurement, the unit of work is the foot-pound, the amount of work needed to lift one pound upward a distance of one foot.

Answers to Student Worksheet

1. The water picks up speed, due to gravity. As the water falls, stored energy changes to energy of motion.
2. While eating moss, moose exchange kinetic energy for chemical potential energy.
3. The ball releases its stored elastic potential energy and rebounds off the racket's strings.

Section Focus Transparency 2 (page 43)

Power Plants

Transparency Teaching Tips

- The concepts covered with this transparency are conversion and conservation of energy. Explain that according to the law of conservation of energy, energy can be neither created nor destroyed. Ask students to describe the energy conversion process, from the Sun through plants to animals. (The Sun's energy is converted by plants through photosynthesis to chemical potential energy; animals eat plants and use the stored chemical potential energy to live.)
- Ask students to define 'calorie' and explain its connection to the process just described.

Content Background

- A calorie is defined as the amount of energy needed to raise the temperature of one gram of water one degree Celsius. The food Calorie that nutritionists use (C) is actually a kilocalorie, or 1,000 calories. The food Calorie is capitalized in text and is sometimes called a large Calorie. The Caloric value of a meal represents how much energy those foods will yield if consumed. For example, a breakfast of scrambled eggs, potato wedges, sausage, and fruit will yield 659 Calories, while a breakfast of a soft-boiled egg, toast, and grapefruit will provide 275 Calories.
- Food not used to create energy is eliminated or stored in the body as fat.
- One ear of corn yields about 90 Calories and has three grams of protein, twenty grams of carbohydrates, and one gram of fat.

Answers to Student Worksheet

1. People eat plants, converting the stored chemical potential energy to various forms or energy to sustain life
2. Answers will vary. Energy is found in water held behind dams, wind, batteries, chemical bonds, compressed springs, etc.

Teaching Transparency (Page 45)

Kinetic Energy

Section 1

Transparency Teaching Tips

- Obtain a toy truck and a toy motorcycle. Have students explain how the motorcycle can start behind the truck, and after a certain distance, be even with the truck.
- Discuss the role that gravity plays in the movement of the truck and motorcycle.

Reteaching Suggestion

- Place a book at the edge of a table and allow it to fall. Point out that the falling book has kinetic energy.

Extensions

Activity: Have students create and write their own kinetic energy problem and solution.

Challenge: Have students use library resources to study kinetic energy and list ways it is part of everyday life.

Answers to Student Worksheet

1. Kinetic energy is energy in the form of motion. Anytime something moves, it has kinetic energy.
2. The truck's mass and velocity affect its kinetic energy.
3. Energy is measured in joules.

4. The truck has more kinetic energy because it has more mass.
5. kinetic energy = $1/2 \text{ mass} \times \text{speed}^2$
 $KE = 1/2 (60 \text{ kg}) \times (100 \text{ m/s})^2$
 $KE = 60(100)^2/2 \text{ Kg m}^2/\text{s}^2$
 $KE = 300,000 \text{ Kg m}^2/\text{s}^2 = 300,000 \text{ J}$

Assessment Transparency (Page 47)

Energy

Section 2

1. C. Students need to analyze examples of potential and kinetic energy in everyday life.
Choice A: No, there are no data in the table to suggest that velocity is being tested.
Choice B: No, there are no data in the table to suggest that nuclear fission is being tested.
Choice C: Yes, the data suggest an experiment in which food Calories are converted into energy.
Choice D: No, the data do not suggest an experiment involving gravity.
2. F. Students need to analyze examples of potential and kinetic energy in everyday life. Additionally, students should be able to organize, examine, and evaluate data.
Choice F: Yes, in order to collect usable data, it is important to keep factors that are not being measured constant.
Choice G: No, time of day has no direct effect on this experiment.
Choice H: No, air temperature has no direct effect on this experiment.
Choice J: No, rate of speed is not relevant to this experiment.
3. D. Students need to analyze examples of potential and kinetic energy in everyday life. Additionally, students should be able to organize, analyze, make inferences, and predict trends from direct and indirect evidence.
Choice A: No, person 1 consumed 250 more Calories than burned.
Choice B: No, person 2 consumed 20 more Calories than burned.
Choice C: No, person 3 consumed 650 more Calories than burned.
Choice D: Yes, person 4 burned ten more Calories than consumed.

Teaching Tip

Instruct students to bring a sweater or sweatshirt in case the testing room is cold.