Heat and Changing States of Matter

AIMS Multimedia is a leading producer and distributor of educational programs serving schools and libraries for nearly 40 years. AIMS draws upon the most up-to-date knowledge, existing and emerging technologies, and all of the instructional and pedagogical resources available to develop and distribute educational programs in film, videocassette, laserdisc, CD-ROM and CD-i formats.

Persons or schools interested in obtaining additional copies of this AIMS Teaching Module, please contact:

AIMS Multimedia

1-800-FOR-AIMS
1-800-367-2467

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Congratulations!

You have chosen a learning program that will actively motivate your students AND provide you with easily accessible and easily manageable instructional guidelines designed to make your teaching role efficient and rewarding.

The AIMS Teaching Module provides you with a video program keyed to your classroom curriculum, instructions and guidelines for use, plus a comprehensive teaching program containing a wide range of activities and ideas for interaction between all content areas. Our authors, educators, and consultants have written and reviewed the AIMS Teaching Modules to align with the Educate America Act: Goals 2000.

This ATM, with its clear definition of manageability, both in the classroom and beyond, allows you to tailor specific activities to meet all of your classroom needs.

RATIONALE

In today's classrooms, educational pedagogy is often founded on Benjamin S. Bloom's "Six Levels of Cognitive Complexity." The practical application of Bloom's Taxonomy is to evaluate students' thinking skills on these levels, from the simple to the complex: Knowledge (rote memory skills), Comprehension (the ability to relate or retell), Application (the ability to apply knowledge outside its origin), Analysis (relating and differentiating parts of a whole), Synthesis (relating parts to a whole), and Evaluation (making a judgment or formulating an opinion).

The AIMS Teaching Module is designed to facilitate these intellectual capabilities, AND to integrate classroom experiences and assimilation of learning with the students' life experiences, realities, and expectations. AIMS' learner verification studies prove that our AIMS Teaching Modules help students to absorb, retain, and to demonstrate ability to use new knowledge in their world. Our educational materials are written and designed for today's classroom, which incorporates a wide range of intellectual, cultural, physical, and emotional diversities.

ORGANIZATION AND MANAGEMENT

To facilitate ease in classroom manageability, the AIMS Teaching Module is organized in four sections. You are reading Section 1, Introduction to the Aims Teaching Module (ATM).

SECTION 2,
INTRODUCING THIS ATM
will give you the specific information you need to integrate the program into your classroom curriculum.

SECTION 3,
PREPARATION FOR VIEWING
provides suggestions and strategies for motivation, language preparedness, readiness, and focus prior to viewing the program with your students.

SECTION 4,
AFTER VIEWING THE PROGRAM
provides suggestions for additional activities plus an assortment of consumable assessment and extended activities, designed to broaden comprehension of the topic and to make connections to other curriculum content areas.

FEATURES

INTRODUCING EACH ATM

SECTION 2

Your AIMS Teaching Module is designed to accompany a video program written and produced by some of the world's most credible and creative writers and producers of educational programming. To facilitate diversity and flexibility in your classroom, your AIMS Teaching Module features these components:

Themes

The Major Theme tells how this AIMS Teaching Module is keyed into the curriculum. Related Themes offer suggestions for interaction with other curriculum content areas, enabling teachers to use the teaching module to incorporate the topic into a variety of learning areas.

Overview

The Overview provides a synopsis of content covered in the video program. Its purpose is to give you a summary of the subject matter and to enhance your introductory preparation.

Objectives

The ATM learning objectives provide guidelines for teachers to assess what learners can be expected to gain from each program. After completion of the AIMS Teaching Module, your students will be able to demonstrate dynamic and applied comprehension of the topic.

PREPARATION FOR VIEWING

SECTION 3

In preparation for viewing the video program, the AIMS Teaching Module offers activity and/or discussion ideas that you may use in any order or combination.

Introduction To The Program

Introduction to the Program is designed to enable students to recall or relate prior knowledge about the topic and to prepare them for what they are about to learn.

Introduction To Vocabulary

Introduction to Vocabulary is a review of language used in the program: words, phrases, usage. This vocabulary introduction is designed to ensure that all learners, including limited English proficiency learners, will have full understanding of the language usage in the content of the program.

Discussion Ideas

Discussion Ideas are designed to help you assess students' prior knowledge about the topic and to give students a preview of what they will learn. Active discussion stimulates interest in a subject and can motivate even the most reluctant learner. Listening, as well as speaking, is active participation. Encourage your students to participate at the rate they feel comfortable. Model sharing personal experiences when applicable, and model listening to students' ideas and opinions.

Focus

Help learners set a purpose for watching the program with Focus, designed to give students a focal point for comprehension continuity.

Jump Right In

Jump Right In provides abbreviated instructions for quick management of the program.

AFTER VIEWING THE PROGRAM

SECTION 4

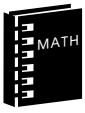
After your students have viewed the program, you may introduce any or all of these activities to interact with other curriculum content areas, provide reinforcement, assess comprehension skills, or provide hands-on and in-depth extended study of the topic.

SUGGESTED ACTIVITIES

The Suggested Activities offer ideas for activities you can direct in the classroom or have your students complete independently, in pairs, or in small work groups after they have viewed the program. To accommodate your range of classroom needs, the activities are organized into skills categories. Their labels will tell you how to identify each activity and help you correlate it into your classroom curriculum. To help you schedule your classroom lesson time, the AIMS hourglass gives you an estimate of the time each activity should require. Some of the activities fall into these categories:

Meeting Individual Needs

These activities are designed to aid in classroom continuity. Reluctant learners and learners acquiring English will benefit from these activities geared to enhance comprehension of language in order to fully grasp content meaning.



Curriculum Connections

Many of the suggested activities are intended to integrate the content of the ATM program into other content areas of the classroom curriculum. These cross-connections turn the classroom teaching experience into a whole learning experience.

Critical Thinking

Critical Thinking activities are designed to stimulate learners' own opinions and ideas. These activities require students to use the thinking process to discern fact from opinion, consider their own problems and formulate possible solutions, draw conclusions, discuss cause and effect, or combine what they already know with what they have learned to make inferences.

Cultural Diversity

Each AIMS Teaching Module has an activity called Cultural Awareness, Cultural Diversity, or Cultural Exchange that encourages students to share their backgrounds, cultures, heritage, or knowledge of other countries, customs, and language.

Hands On

These are experimental or tactile activities that relate directly to the material taught in the program.Your students will have opportunities to make discoveries and formulate ideas on their own, based on what they learn in this unit.

Writing

Every AIMS Teaching Module will contain an activity designed for students to use the writing process to express their ideas about what they have learned. The writing activity may also help them to make the connection between what they are learning in this unit and how it applies to other content areas.

In The Newsroom

Each AIMS Teaching Module contains a newsroom activity designed to help students make the relationship between what they learn in the classroom and how it applies in their world. The purpose of In The Newsroom is to actively involve each class member in a whole learning experience. Each student will have an opportunity to perform all of the tasks involved in production: writing, researching, producing, directing, and interviewing as they create their own classroom news program.

Extended Activities

These activities provide opportunities for students to work separately or together to conduct further research, explore answers to their own questions, or apply what they have learned to other media or content areas.

Link to the World

These activities offer ideas for connecting learners' classroom activities to their community and the rest of the world.

Culminating Activity

To wrap up the unit, AIMS Teaching Modules offer suggestions for ways to reinforce what students have learned and how they can use their new knowledge to enhance their world view.

VOCABULARY

Every ATM contains an activity that reinforces the meaning and usage of the vocabulary words introduced in the program content. Students will either read or find the definition of each vocabulary word, then use the word in a written sentence.

CHECKING COMPREHENSION

Checking Comprehension is designed to help you evaluate how well your students understand, retain, and recall the information presented in the AIMS Teaching Module. Depending on your students' needs, you may direct this activity to the whole group yourself, or you may want to have students work on the activity page independently, in pairs, or in small groups. Students can verify their written answers through discussion or by viewing the video a second time. If you choose, you can reproduce the answers from your Answer Key or write the answer choices in a Word Bank for students to use. Students can use this completed activity as a study guide to prepare for the test.

CONSUMABLE ACTIVITIES

The AIMS Teaching Module provides a selection of consumable activities, designed to specifically reinforce the content of this learning unit. Whenever applicable, they are arranged in order from low to high difficulty level, to allow a seamless facilitation of the learning process. You may choose to have students take these activities home or to work on them in the classroom independently, in pairs or in small groups.

CHECKING VOCABULARY

The Checking Vocabulary activity provides the opportunity for students to assess their knowledge of new vocabulary with this word game or puzzle. The format of this vocabulary activity allows students to use the related words and phrases in a different context.

TEST

The AIMS Teaching Module Test permits you to assess students' understanding of what they have learned. The test is formatted in one of several standard test formats to give your students a range of experiences in test-taking techniques. Be sure to read, or remind students to read, the directions carefully and to read each answer choice before making a selection. Use the Answer Key to check their answers.

ADDITIONAL AIMS MULTIMEDIA PROGRAMS

After you have completed this AIMS Teaching Module you may be interested in more of the programs that AIMS offers. This list includes several related AIMS programs.

ADDITIONAL READING SUGGESTIONS

AIMS offers a carefully researched list of other resources that you and your students may find rewarding.

ANSWER KEY

Reproduces tests and work pages with answers marked.

Heat and Changing States of Matter

THEMES

Heat and Changing States of Matter explores the basic aspects of heat and thermal energy. Heat of fusion and heat of vaporization are covered, in addition to expansion and contraction. The transfer of heat through conduction, convection and radiation are also discussed, as well as the heat capacity of various types of matter.

OVERVIEW

Heat causes matter to change states through expansion or contraction of molecules. The amount of motion in a molecule is a reflection of its kinetic energy. Temperature is a measure of the average kinetic energy of the molecules making up an object. If we apply thermal energy to a material, we can increase its kinetic energy and cause it to change states. Heat is measured in units called calories. Some materials, such as coal, have stored or potential energy. This energy is released as the coal burns. The heat necessary to change a substance from a solid to a liquid, with no temperature increase occurring, is called the heat of fusion. The heat necessary to convert boiling water to steam is called the heat of vaporization. Most materials expand as they get hotter and contract as they get cooler.

OBJECTIVES

- To learn more about the characteristics of heat and thermal energy.
- To discuss the various aspects of conduction, convection and radiation.
- To examine heat of fusion and heat of vaporization.
- To better understand how heat is measured and controlled.
- To explore thermal conductance and heat capacity.

Use this page for your individual notes about planning and/or effective ways to manage this AIMS Teaching Module in your classroom.

Our AIMS Multimedia Educational Department welcomes your observations and comments. Please feel free to address your correspondence to:

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INTRODUCTION TO THE PROGRAM

The presence of heat on the Earth is the basis of all life. Heat is one of the most important elements known to humans. It is used to warm our homes, provide us with light, cook our food, and produce fuel used for transportation and electricity. We can see basic examples of heat all around us. A breeze is created by warm air that is replaced by cool air. A warm stove heats a room as currents circulate the warm air. Infrared rays from the sun cause our skin to burn. These physical examples of heat are best understood if we examine the aspects of heat on a molecular level. In fact, it is the increased movement of invisible molecules that create heat in all substances.

INTRODUCTION TO VOCABULARY

Before starting the program, write the word "thermal" on the board. What does this word mean to students? Where have they heard this word, or related words, before?

(Thermal means "relating to or caused by heat." Some related words include: thermal underwear, thermos, thermometer, thermodynamics, thermonuclear and thermostat.)

DISCUSSION IDEAS

The heat that we use on Earth comes from six main sources. Can students name all six sources? What are some ways that we use heat from these sources? (The six main sources of heat are the sun, fire, friction, nuclear energy, chemical reactions, and heat within the Earth. Heat from the sun warms solar panels that make electrical energy. Heat from fire is used to cook food and produce fuel. Heat from the friction of two sticks rubbing together can help us build a campfire. Lighting a match is an example of a useful chemical reaction that produces heat. Nuclear energy is used to produce electricity for heating our homes.)

FOCUS

Ask students to think about the various applications of heat. What are some ways that students used heat before getting to class today? What would their day have been like without heat? Ask them to keep these things in mind as they begin the unit.

JUMP RIGHT IN

HOW TO USE THE HEAT AND CHANGING STATES OF MATTER AIMS TEACHING MODULE

Preparation

- Read *Heat and Changing States of Matter* **Themes, Overview,** and **Objectives** to become familiar with program content and expectations.
- Use **Preparation for Viewing** suggestions to introduce the topic to students.

Viewing HEAT AND CHANGING STATES OF MATTER

- Set up viewing monitor so that all students have a clear view.
- Depending on your classroom size and learning range, you may choose to have students view *Heat and Changing States of Matter* together or in small groups.
- Some students may benefit from viewing the video more than one time.

After Viewing HEAT AND CHANGING STATES OF MATTER

- Select **Suggested Activities** that integrate into your classroom curriculum. If applicable, gather materials or resources.
- Choose the best way for students to work on each activity. Some activities work best for the whole group. Other activities are designed for students to work independently, in pairs, or in small groups. Whenever possible, encourage students to share their work with the rest of the group.
- Duplicate the appropriate number of **Vocabulary, Checking Comprehension**, and consumable activity pages for your students.
- You may choose to have students take consumable activities home, or complete them in the classroom, independently, or in groups.
- Administer the Test to assess students' comprehension of what they have learned, and to provide them with practice in test-taking procedures.
- Use the **Culminating Activity** as a forum for students to display, summarize, extend, or share what they have learned with each other, the rest of the school, or a local community organization.

SUGGESTED ACTIVITIES

Writing

60 Minutes

The scientists listed below worked to help us have a better understanding of heat. Ask students to choose a scientist from the list. Have each student write a one-page summary of their chosen person's contributions to the understanding of heat. Encourage students to use library books and encyclopedia articles to learn more about their chosen topics.

Nicolas Carnot
Rudolf Clausius
Sir Humphry Davy
Josiah Gibbs
James Joule
Lord Kelvin
Julius R. von Mayer
Benjamin Thompson

Meeting Individual Needs

20 Minutes

Ask students to make sentences using the following words. Encourage them to use a dictionary if they are uncertain of the meanings. Make sure that their sentences display an understanding of the words as they relate to the program.

- conduction - transmission of heat by thermal energy from particle to particle
- convection - transfer of heat that occurs when thermal energy causes currents to form in gases or liquids
- radiation - process whereby energy in the form of light rays or heat is transmitted from atoms and molecules as they undergo internal changes

Link to the World

20 Minutes

Heat is a very important element in our daily lives. Ask students to name some important uses of heat. Remind them to include uses that are related to transportation, industry and health care. (We use heat to furnish the energy that makes automobiles, airplanes and trains move. Heat is also used in factories to make many of the products we use, including plastic items, food products and things made from metals and alloys. Heat also generates electricity which we use to warm our homes, produce light and operate appliances. Scientists and medical professionals use heat to kill bacteria and perform chemical experiments. Heat is also used to destroy garbage and human waste materials.)

Hands On

60 Minutes

The following experiment will explain a common example of convection. Students will need a jar of soil, a jar of water and 2 thermometers. Place a thermometer in each of the jars. Set the jars in a patch of sunlight and record the temperature changes. Which material heats more quickly, the water or the soil? (The soil heats more quickly.)

Remove the jars from the sunlight, and record the temperature changes again. Which material cools off more quickly, the water or the soil? (The soil cools off more quickly.)

Ask students if they have ever felt a breeze at the beach. How can the experiment above explain this phenomenon? (During the day, the ground warms up and becomes warmer than the sea. Warm air over the ground rises as cooler air over the ocean comes in. This causes a breeze. At night, the ground is cooler than the water. Air over the ocean rises while air over the ground blows away. This also causes a breeze.)

In the Newsroom

60 Minutes

Ask students to watch a television news broadcast, watching closely for stories related to heat or thermal energy. Have them keep a list of these stories and how they relate to heat. Remind them that many everyday occurrences are linked to thermal energy, including space exploration, medical research, energy conservation, weather occurrences and industry.

Encourage students to share their findings in a class discussion. How many unexpected topics were discovered? Did any stories relate to conduction, convection or radiation? Which ones?

Extended Activity

15 Minutes

When something is added to water, the water solution's freezing point is lowered.This means it will take the solution longer to freeze than ordinary water. Ask students to consider the following substances: ordinary water, water that has just been boiled and saltwater. Which substance will freeze first? Which substances will freeze second and third? Why?

(Water that has just been boiled will freeze first because most of its air has been released. This raises its freezing point. Ordinary water will freeze next, and saltwater will freeze last. The added salt raises its freezing point.)

Critical Thinking

20 Minutes

Heat causes many physical changes in our world. Ask students to use what they know about heat to answer the following questions. Why do telephone wires sag on a hot day and tighten into straight lines on a cold day? Why is a jar lid easier to remove if it has been placed under hot water? Why do people in hot, desert countries wear white clothing over their arms and legs instead of wearing short-sleeved shirts and short pants? Why do architects leave gaps between sections of buildings and bridges?

(Telephone wires sag on a hot day because heat makes them expand and grow in length. On a cold day, they contract or shorten. Placing a jar lid under hot water makes the lid expand. This loosens the lid's grip on the jar and makes its easier to remove the lid. People in hot, desert countries wear long white garments to protect themselves from the sun. White reflects heat and provides more protection and a cooler temperature than bare skin would. Architects leave gaps in bridges and buildings because all structures expand in hot weather. If there were no gaps to make room for this expansion, the structures would buckle and eventually fall down.)

Connection to History

30 Minutes

Scientists don't know exactly when early humans began using fire, but the discovery was a major turning point in our history. How might the first fires witnessed by humans have started? What methods might have been used to ignite and control fire? What important uses did fire have for early civilizations?

(The first fires were probably ignited by lightening flashes, sparks from an erupting volcano, or as a result of sunlight burning dried leaves. People probably saw how sparks led to fire. They learned to use flint and other materials to produce these sparks and start fires. Leaves and wood were probably used to control the fires. Early humans used fire to stay warm, cook food, provide light for nighttime activities, make pottery from clay, clear forests to grow food, keep animals away, and forge weapons and tools from metals.)

Culminating Activity

60 Minutes

Using what they have learned in the unit, ask each student to write a question related to the program. Collect the questions and use them to write a review quiz. After giving the quiz, ask students if they enjoyed designing the test. How would they feel about designing more tests in the future?

Name

VOCABULARY

The following terms are from *Heat and Changing States of Matter*. Fill in the number of each term next to its closest definition.

1. boiling point
2. calorie
3. conduction
4. convection
5. expansion
6. friction
7. fusion
8. heat
9. radiation
10. resistance

___ process of kinetic energy that causes molecules to vibrate against each other, increasing heat and friction

___ transmission of heat by thermal energy from particle to particle

___ a material's ability to insulate heat

___ resistance of motion that occurs when one object touches another

___ amount of thermal energy that one object is able to transfer to another; measured in calories

___ temperature at which a liquid being heated reaches a peak temperature and can get no hotter

___ joining of the nuclei of two atoms to form the nucleus of a heavier element

___ process whereby energy in the form of light rays or heat is transmitted from atoms and molecules as they undergo internal changes

___ amount of energy required to raise the temperature of one gram of water one degree Celsius

___ transfer of heat that occurs when thermal energy causes currents to form in fluids and gases

Name

CHECKING COMPREHENSION

Read the following sentences and circle the letter of the word that best fills each blank.

Heat causes the ___1___ of matter to change by expansion or contraction of molecules. The amount of ___2___ in a molecule is a reflection of its kinetic energy. ___3___ is a measure of the average kinetic energy of the molecules making up an object. If we apply ___4___ energy to a material, we can increase its kinetic energy and cause it to change states. Heat is measured in units called ___5___ . Some materials, such as coal, have stored or ___6___ energy. This energy is released as the coal burns. The heat necessary to change a substance from a solid to a liquid, with no temperature increase occurring, is called the heat of ___7___ . The heat necessary to convert boiling water to steam is called the heat of ___8___ . Most materials ___9___ as they get hotter and ___10___ as they get cooler.

1. A. atomic structure
   B. state
   C. color
   D. boiling point

2. A. protons
   B. mass
   C. motion
   D. volume

3. A. Density
   B. Vapor point
   C. Fusion level
   D. Temperature

4. A. thermal
   B. potential
   C. solid
   D. liquid

5. A. hertz
   B. joules
   C. watts
   D. newtons

6. A. potential
   B. thermal
   C. nuclear
   D. radiation

7. A. vaporization
   B. expansion
   C. contraction
   D. fusion

8. A. convection
   B. vaporization
   C. conductance
   D. thermodynamics

9. A. expand
   B. contract
   C. insulate
   D. convect

10. A. vaporize
    B. conduct
    C. expand
    D. contract

Name

MATTER MATCH-UP

Match each term on the left with the best group of words on the right.

1. energy
2. First Law of Thermodynamics
3. gas
4. heat of fusion
5. heat of vaporization
6. insulator
7. joule
8. kinetic energy
9. nuclear energy
10. Second Law of Thermodynamics

energy of motion

state in which a substance can expand indefinitely and completely fill its container

states that when two objects of differing temperatures come in contact with each other, thermal energy will be transferred from the warmer object to the cooler object

heat necessary to convert boiling water to steam

states that energy is never created or destroyed, but can only change form

unit used to measure thermal energy

energy released when an atom is split apart

force, such as heat, that can change form, but cannot be destroyed

heat necessary to covert a solid to a liquid while no temperature increase occurs

material that is a poor conductor of thermal energy

Name

TRUE OR FALSE

Place a T next to statements that are true and an F next to statements that are false.

1. ___ The energy of motion is called potential energy.
2. ___ Applying thermal energy to a material increases its kinetic energy.
3. ___ Wind blows as a result of heavier, colder air moving to displace warmer, lighter air.
4. ___ The amount of electrical energy produced by burning coal will exceed the potential energy available in the coal.
5. ___ The total amount of energy in a closed, isolated system will remain constant.
6. ___ Gases expand because the force of attraction between molecules is too weak to overcome their kinetic energy.
7. ___ After reaching its boiling point, water will continue to get hotter if more heat is applied.
8. ___ All materials exposed to heat expand at the same basic rate.
9. ___ Walking barefoot across hot sand is an example of conduction.
10. ___ Materials that are good conductors of thermal energy are known as insulators.

Name

TRANSFERRING THERMAL ENERGY

Each item below describes an example of thermal energy. For each item, write the word which best explains what is happening: conduction, convection or radiation.

1. _____ Someone places a hand on a metal table and the hand feels cooler.
2. _____ Hot air currents inside a balloon causes the balloon to rise.
3. _____ Energy from the sun travels to the surface of the Earth.
4. _____ Storm clouds form when warm air moves into the atmosphere.
5. _____ Heat from a stove warms a pot of soup.
6. _____ A person turns on a lamp and feels its warmth on his hand.
7. _____ The heat from a space heater rises to the top of a room and is replaced by cooler air.
8. _____ A metal spoon stirring a cup of hot chocolate becomes warm.
9. _____ Water in a swimming pool is warmed by the sun.
10. _____ A person swimming in the ocean begins to feel cooler.

Name

CONDUCTOR OR INSULATOR?

For each item listed below, write a "C" if the item is acting as a conductor of heat and an "I" if the item is acting as an insulator of heat.

1. ____ plastic handle of a frying pan
2. ____ copper tea kettle
3. ____ cloth jacket
4. ____ wooden walls of a house
5. ____ oven mitts
6. ____ copper wires used to heat an electric blanket
7. ____ aluminum surface of a cooking pot
8. ____ wool hat
9. ____ metal radiator
10. ____ feathers of a bird

Name

WORD SEARCH

The following words can be found in the maze below. The letters may be arranged horizontally, vertically, diagonally or backward.

amplitude
crest
decibel
Doppler
frequency
hertz
seismic
spectrum
trough
wave

g b d n k q p n k o r e
A M P L I T U D E t I o
I H h q g T R O U G H r
S I E k b q n P j b S I
E h s R d p g P r j P e
I a e p T n x L b I E n
S m p e m Z p E q d C g
M h c a z m C R E S T s
I o D E C I B E L q R o
C m h j a s d j I g U m
v F R E Q U E N C Y M j
w c n c p r p s E V A W

Name

TEST

Circle the phrase which best answers each question.

1. All forms of energy have the ability to:

   - heat.
   - do work.
   - produce nuclear reactions.
   - produce electricity.

2. Heat is the amount of _____ one object can transfer to another.

   - convection.
   - expansion.
   - thermal energy.
   - molecules.

3. The Law of Conservation of Energy states that the total amount of energy in any closed, isolated system:

   - always changes.
   - contracts.
   - remains constant.
   - expands.

4. The heat needed to convert a solid to a liquid while no temperature increase occurs is called:

   - heat of vaporization.
   - heat of expansion.
   - heat of fusion.
   - heat capacity.

5. The rise of mercury in a thermometer is an example of:

   - convection.
   - radiation.
   - boiling point.
   - expansion.

Name

TEST (CONTINUED)

6. Convection can occur only in:

   - solids and liquids.
   - solids and gases.
   - solids and plasmas.
   - liquids and gases.

7. The greenhouse effect is a result of heat transferred through:

   - radiation.
   - convection.
   - conduction.
   - vaporization.

8. The only process that can transfer heat energy in a solid is:

   - vaporization.
   - convection.
   - radiation.
   - conduction.

9. Which of the following is not a state of matter?

   - radiation
   - plasma
   - liquid
   - gas

10. The application of thermal energy to aluminum increases the _____ of the aluminum.

    - kinetic energy
    - boiling point
    - melting point
    - potential energy

ADDITIONAL AIMS MULTIMEDIA PROGRAMS

You and your students might also enjoy these other AIMS Multimedia programs:

Physics Essentials Series

- *Electricity: The Invisible River of Energy*
- *Waves: Energy in Motion*
- *Motion: Newton's Three Laws*
- *Light, Lenses, and Lasers*
- *Force and Work: Energy in Action*

ANSWER KEY for page 18

VOCABULARY

The following terms are from *Heat and Changing States of Matter*. Fill in the number of each term next to its closest definition.

1. boiling point
2. calorie
3. conduction
4. convection
5. expansion
6. friction
7. fusion
8. heat
9. radiation
10. resistance

5 process of kinetic energy that causes molecules to vibrate against each other, increasing heat and friction

3 transmission of heat by thermal energy from particle to particle

10 a material's ability to insulate heat

6 resistance of motion that occurs when one object touches another

8 amount of thermal energy that one object is able to transfer to another; measured in calories

1 temperature at which a liquid being heated reaches a peak temperature and can get no hotter

7 joining of the nuclei of two atoms to form the nucleus of a heavier element

9 process whereby energy in the form of light rays or heat is transmitted from atoms and molecules as they undergo internal changes

2 amount of energy required to raise the temperature of one gram of water one degree Celsius

4 transfer of heat that occurs when thermal energy causes currents to form in fluids and gases

ANSWER KEY for page 19

CHECKING COMPREHENSION

Read the following sentences and circle the letter of the word that best fills each blank.

Heat causes the ___1___ of matter to change by expansion or contraction of molecules. The amount of ___2___ in a molecule is a reflection of its kinetic energy. ___3___ is a measure of the average kinetic energy of the molecules making up an object. If we apply ___4___ energy to a material, we can increase its kinetic energy and cause it to change states. Heat is measured in units called ___5___ . Some materials, such as coal, have stored or ___6___ energy. This energy is released as the coal burns. The heat necessary to change a substance from a solid to a liquid, with no temperature increase occurring, is called the heat of ___7___ . The heat necessary to convert boiling water to steam is called the heat of ___8___ . Most materials ___9___ as they get hotter and ___10___ as they get cooler.

1. A. atomic structure
   (B.) state
   C. color
   D. boiling point

2. A. protons
   B. mass
   (C.) motion
   D. volume

3. A. Density
   B. Vapor point
   C. Fusion level
   (D.) Temperature

4. (A.) thermal
   B. potential
   C. solid
   D. liquid

5. A. hertz
   (B.) joules
   C. watts
   D. newtons

6. (A.) potential
   B. thermal
   C. nuclear
   D. radiation

7. A. vaporization
   B. expansion
   C. contraction
   (D.) fusion

8. A. convection
   (B.) vaporization
   C. conductance
   D. thermodynamics

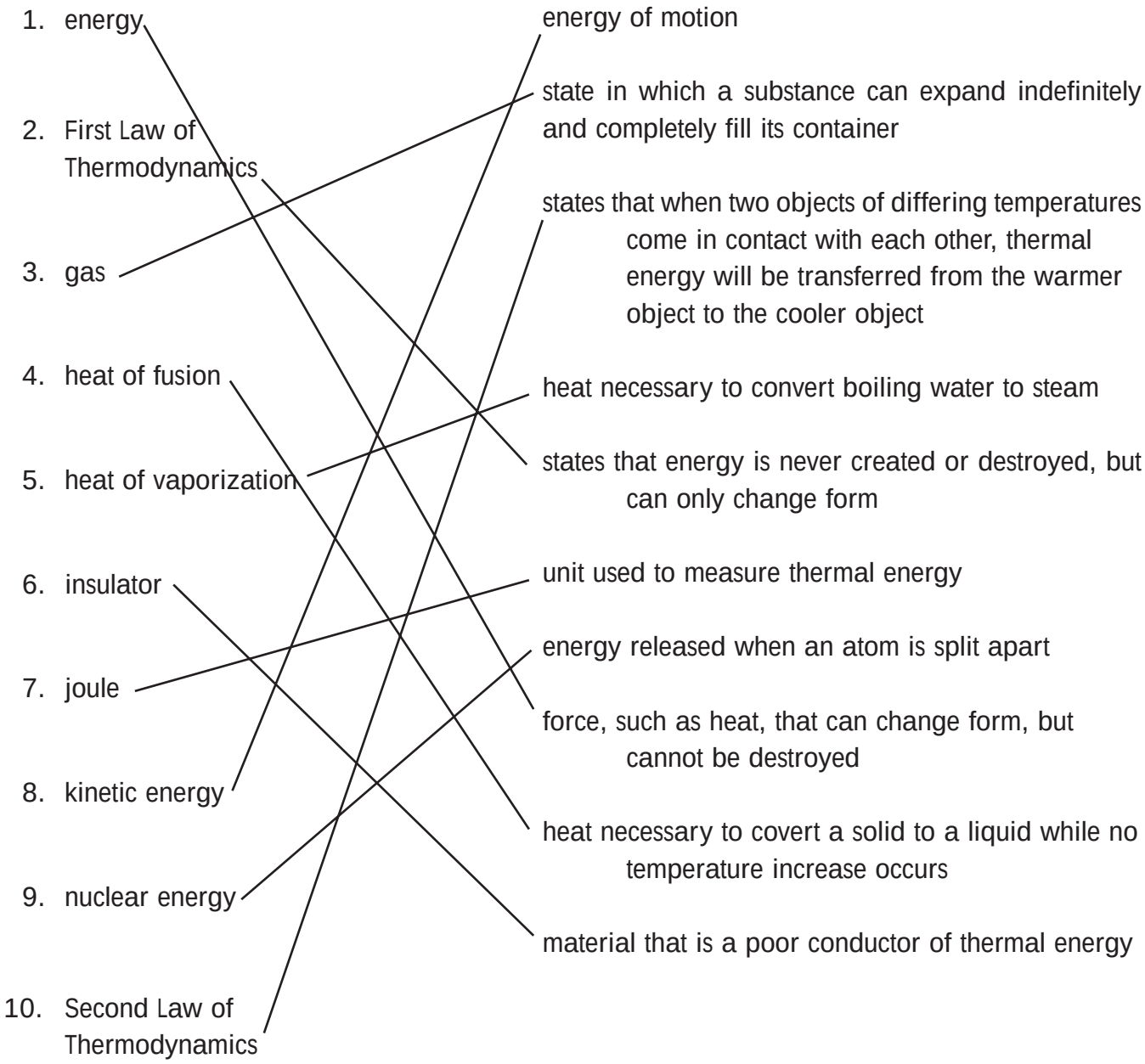
9. (A.) expand
   B. contract
   C. insulate
   D. convect

10. A. vaporize
    B. conduct
    C. expand
    (D.) contract

ANSWER KEY for page 20

MATTER MATCH-UP

Match each term on the left with the best group of words on the right.



ANSWER KEY for page 21

TRUE OR FALSE

Place a T next to statements that are true and an F next to statements that are false.

1. **F** The energy of motion is called potential energy.
2. **T** Applying thermal energy to a material increases its kinetic energy.
3. **T** Wind blows as a result of heavier, colder air moving to displace warmer, lighter air.
4. **F** The amount of electrical energy produced by burning coal will exceed the potential energy available in the coal.
5. **T** The total amount of energy in a closed, isolated system will remain constant.
6. **T** Gases expand because the force of attraction between molecules is too weak to overcome their kinetic energy.
7. **F** After reaching its boiling point, water will continue to get hotter if more heat is applied.
8. **F** All materials exposed to heat expand at the same basic rate.
9. **T** Walking barefoot across hot sand is an example of conduction.
10. **F** Materials that are good conductors of thermal energy are known as insulators.

ANSWER KEY for page 22

TRANSFERRING THERMAL ENERGY

Each item below describes an example of thermal energy. For each item, write the word which best explains what is happening: conduction, convection or radiation.

1. **conduction** Someone places a hand on a metal table and the hand feels cooler.
2. **convection** Hot air currents inside a balloon causes the balloon to rise.
3. **radiation** Energy from the sun travels to the surface of the Earth.
4. **convection** Storm clouds form when warm air moves into the atmosphere.
5. **conduction** Heat from a stove warms a pot of soup.
6. **radiation** A person turns on a lamp and feels its warmth on his hand.
7. **convection** The heat from a space heater rises to the top of a room and is replaced by cooler air.
8. **conduction** A metal spoon stirring a cup of hot chocolate becomes warm.
9. **radiation** Water in a swimming pool is warmed by the sun.
10. **conduction** A person swimming in the ocean begins to feel cooler.

ANSWER KEY for page 23

CONDUCTOR OR INSULATOR?

For each item listed below, write a "C" if the item is acting as a conductor of heat and an "I" if the item is acting as an insulator of heat.

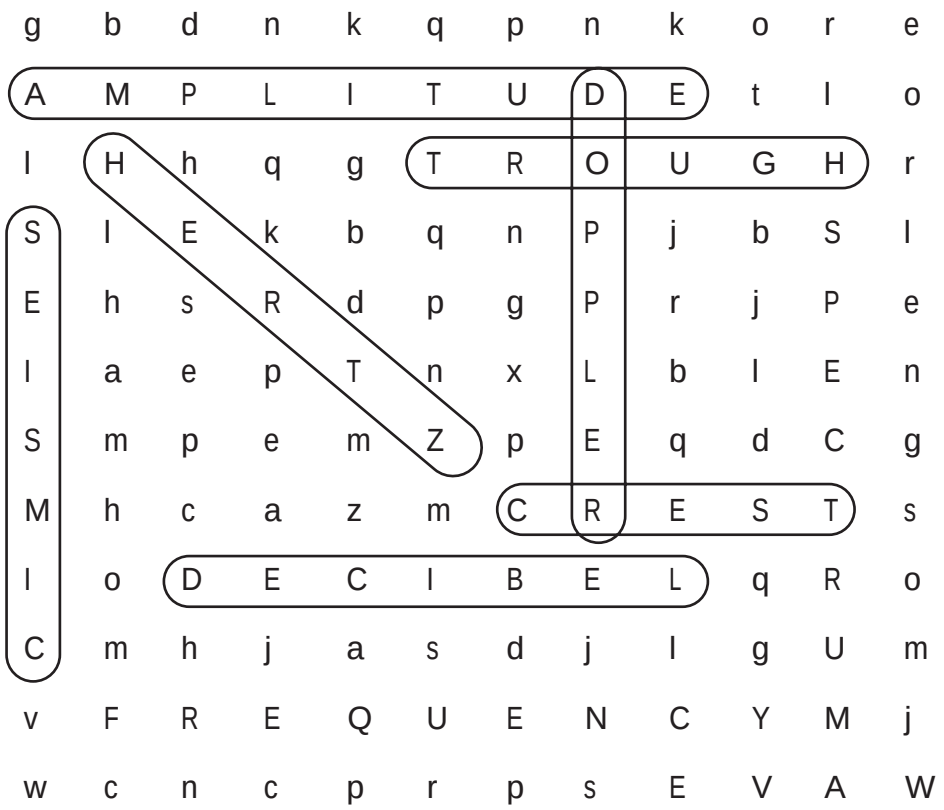
1. **I** plastic handle of a frying pan
2. **C** copper tea kettle
3. **I** cloth jacket
4. **I** wooden walls of a house
5. **C** oven mitts
6. **C** copper wires used to heat an electric blanket
7. **C** aluminum surface of a cooking pot
8. **I** wool hat
9. **C** metal radiator
10. **I** feathers of a bird

ANSWER KEY for page 24

WORD SEARCH

The following words can be found in the maze below. The letters may be arranged horizontally, vertically, diagonally or backward.

amplitude
crest
decibel
Doppler
frequency
hertz
seismic
spectrum
trough
wave



ANSWER KEY for page 25

TEST

Circle the phrase which best answers each question.

1. All forms of energy have the ability to:

   - heat.
   - **do work.**
   - produce nuclear reactions.
   - produce electricity.

2. Heat is the amount of _____ one object can transfer to another.

   - convection.
   - expansion.
   - **thermal energy.**
   - molecules.

3. The Law of Conservation of Energy states that the total amount of energy in any closed, isolated system:

   - always changes.
   - contracts.
   - **remains constant.**
   - expands.

4. The heat needed to convert a solid to a liquid while no temperature increase occurs is called:

   - heat of vaporization.
   - heat of expansion.
   - **heat of fusion.**
   - heat capacity.

5. The rise of mercury in a thermometer is an example of:

   - convection.
   - radiation.
   - boiling point.
   - **expansion.**

TEST (CONTINUED)

6. Convection can occur only in:

   - solids and liquids.
   - solids and gases.
   - solids and plasmas.
   - liquids and gases.

7. The greenhouse effect is a result of heat transferred through:

   - radiation.
   - convection.
   - conduction.
   - vaporization.

8. The only process that can transfer heat energy in a solid is:

   - vaporization.
   - convection.
   - radiation.
   - conduction.

9. Which of the following is not a state of matter?

   - radiation
   - plasma
   - liquid
   - gas

10. The application of thermal energy to aluminum increases the _____ of the aluminum.

    - kinetic energy
    - boiling point
    - melting point
    - potential energy