Physical Science II

Text: Glencoe’s Physical Science

Module 6

Heat

“Thermal Energy”

- Using the worksheets as a guide, read Chapter 6 and complete worksheets. The margins are wider than most worksheets so you can write notes to yourself about what you have read as you read the text.

- Foldables are an easy way to help you organize your thoughts from the reading. Ask for a sheet of paper, and fold the paper so it is easy to tear. Create the foldables which are presented at the beginning of the chapter.

- Complete the Study Guide which accompanies the worksheets.

- Complete the Chapter 6 Video Lab with assistance from instructor.

- When you have successfully completed the chapter worksheets and study guides, you are ready for the test.
Thermal Energy

Before You Read

Before you read the chapter, use the “What I Know” column to list three things you know about heat and thermal energy. Then list three questions you have about thermal energy in the “What I Want to Find Out” column.

<table>
<thead>
<tr>
<th>K</th>
<th>What I know</th>
<th>W</th>
<th>What I want to find out</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

**Foldables Study Organizer**

Construct the Foldable as directed at the beginning of this chapter.

**Science Journal**

Describe things you do to make yourself feel warmer and cooler.

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Thermal Energy
Read the section objectives. Write three questions that come to mind.

1. 

2. 

3. 

Define kinetic energy by using it in a sentence.

kinetic energy

Use your book or a dictionary to define the following key terms.

temperature

thermal energy

heat

specific heat

Look up the word random in a dictionary. Then use the definition to describe the phrase random motion.

random
Section 1 Temperature and Heat (continued)

Main Idea

Temperature
I found this information on page ____________.

Thermal Energy
I found this information on page ____________.

Heat
I found this information on page ____________.

Specific Heat
I found this information on page ____________.

Details

Compare the motion of hot atoms or molecules to cold atoms or molecules.

Analyze how each of the three actions in the table increases the kinetic, potential, or total thermal energy of a substance.

<table>
<thead>
<tr>
<th>Actions that Increase Thermal Energy</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>raise the temperature of the object</td>
<td></td>
</tr>
<tr>
<td>pull atoms or molecules that attract one another farther apart</td>
<td></td>
</tr>
<tr>
<td>add mass to the object, without changing its temperature</td>
<td></td>
</tr>
</tbody>
</table>

Model the flow of heat from a hot object to a cold one. Show the heat flow and some particles in the hot and cold objects.

Compare and contrast what happens in a metal to what happens to a mass of water when each is heated.
Section 1 Temperature and Heat (continued)

Main Idea

I found this information on page ____________.

Details

Evaluate the amount of energy lost from a 0.5 kg glass casserole dish when it is placed in water. The dish's temperature changes from 110°C to 50°C.

Hints:
1. Start by writing the equation for the change in thermal energy of an object.
2. Find the specific heat for glass in the table in your book.

Measuring Specific Heat

I found this information on page ____________.

Sequence steps to use a calorimeter to find the specific heat of a material. Include steps for measurement and steps for calculation.

1. ____________
2. ____________
3. ____________

CONNECT IT

Describe some processes in nature or daily life that depend on the high specific heat of water.

________________________
________________________
________________________
________________________
Directions: Use the terms from the word bank to complete the summary statements.

- collisions
- heat
- temperature
- cooler
- kinetic energy
- thermal energy
- faster
- potential energy
- warmer

As the (1) ________________ of an object increases, the particles in the object move (2) ________________. As a result the average (3) ________________ of the particles increases. The sum of the kinetic energy and the (4) ________________ of the particles in an object is the (5) ________________ of the object. When a substance at a higher temperature comes in contact with a substance at a lower temperature, (6) ________________ between the particles in the two substances cause thermal energy to move from the (7) ________________ object to the (8) ________________ object. Thermal energy that flows due to a difference in temperature is (9) ________________.

Directions: Explain steps and measurements to be made when using a calorimeter to measure the specific heat of a material.

10.
11.
12.
13.
14.
15.
Skim Section 2 of your text. Read the headings and the illustration captions. Write four questions that come to mind.

1. 
2. 
3. 
4. 

Define density in a sentence that shows its scientific meaning.

density

Use your book or a dictionary to define the following key terms.

conduction

convection

radiation

insulator

Use a dictionary to define the word adapt.

adapt
Section 2 Transferring Thermal Energy (continued)

**Main Idea**

**Details**

Complete the table with what you have learned about the different ways thermal energy can be transferred.

<table>
<thead>
<tr>
<th>Description</th>
<th>Sketch</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduction:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convection:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conduction

I found this information on page ________.

Convection

I found this information on page ________.

Radiation

I found this information on page ________.
### Main Idea

**Controlling Heat Flow**

I found this information on page ________.

### Details

Organize the heat-controlling features of some animals in the following table. Write the feature and describe its role in helping the animal control heat.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Feature</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antarctic fur seal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emperor penguin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desert spiny lizard</td>
<td>scaly skin</td>
<td>reflects Sun's rays</td>
</tr>
</tbody>
</table>

### Insulators

I found this information on page ________.

### Analyze

Analyze how the vacuum between the inner and outer walls of a thermos bottle limits heat loss through conduction and convection.

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### Connect It

List the methods you use to control the flow of heat to and from your body. Explain the purpose of each method.

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Thermal Energy 63
Transferring Thermal Energy

Directions: Determine whether the italicized term makes each statement true or false. If the statement is true, write true in the blank. If the statement is false, write in the blank the term that makes the statement true.

1. Materials that are poor conductors are poor insulators.

2. The transfer of energy through matter by direct contact of its particles is convection.

3. The transfer of energy in the form of invisible waves is conduction.

4. Solids usually conduct heat better than liquids and gases.

5. The R-value of insulation indicates its resistance to heat flow.

6. Air is a poor heat conductor.

7. Wind and ocean currents are examples of conduction currents.

8. Energy is usually transferred in fluids by radiation.

9. As water is heated, it expands, becomes less dense, and rises.


11. Only radiant energy that is reflected is changed to thermal energy.

12. The higher the R-value of insulation the less resistant it is to heat flow.

Directions: Circle the object in each pair that will take in more heat. In the blank, explain why that object will take in more heat.

13. a silver spoon __________________________
   a wooden log __________________________

14. a white shirt __________________________
   a red shirt __________________________

15. foil in the sunlight __________________________
   a sidewalk in the sunlight __________________________

16. single-pane window __________________________
   double-pane window __________________________

17. R-5 insulation __________________________
   R-35 insulation __________________________

20 Transferring Thermal Energy
Thermal Energy
Section 3 Using Heat

Predict Read the title of Section 3. List three things that might be discussed in this section.

1. 
2. 
3. 

Review Vocabulary Define the word work in a sentence to reflect its scientific meaning.

work

New Vocabulary Read the definitions below, then write the key term for each one in the left column.

a device that converts heat into work
the study of the relationship among thermal energy, heat, and work
a heating system that absorbs radiant energy from the Sun
impossible for heat to flow from a cool object to a warmer object unless work is done
a heat engine that burns fuel in internal chambers
the increase in thermal energy of a system equals the work done on the system plus the heat transferred to the system

Academic Vocabulary Use a dictionary to define the word cycle.

cycle

64 Thermal Energy
Section 3 Using Heat (continued)

Main Idea

Heating Systems
I found this information on page ________.

Details

Compare and contrast forced-air, radiator-based, and electric heating systems for buildings.

<table>
<thead>
<tr>
<th>System Type</th>
<th>Heat Source</th>
<th>How Heat is Transported</th>
<th>How Heat Spreads</th>
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</table>

Solar Heating
I found this information on page ________.

Sequence how solar collectors work.

1. __________________________________________

2. __________________________________________

3. __________________________________________

4. __________________________________________

Thermodynamics
I found this information on page ________.

Complete the equation which defines the first law of thermodynamics.

\[
\text{Increase in } \frac{\text{of system}}{\text{on system}} + \frac{\text{to system}}{\text{on system}} = 0
\]

Contrast the characteristics of an open system and a closed system.

________________________________________________________________________
Section 3 Using Heat (continued)

Main Idea

Converting Heat to Work
I found this information on page __________.

Sequence the four strokes of a standard automobile engine in their functional order. Fill in the other columns to describe what happens during each stroke.

<table>
<thead>
<tr>
<th>Name of Stroke</th>
<th>Which valves are open?</th>
<th>What are gases doing?</th>
<th>Piston movement (up/down)</th>
<th>Power generated? (yes/no)</th>
</tr>
</thead>
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</table>

Heat Movers
I found this information on page __________.

Summarize the steps a refrigerator takes to transfer heat by filling in the blanks with words from the word bank. Some words may be used more than once.

- Liquid coolant changes into a __________. In doing so, it becomes __________.
- Cold gas absorbs __________ from refrigerator interior, and the gas becomes __________.
- Gas releases __________ to the room, and the gas becomes __________. The gas turns into a __________.
- The compressor does __________ compressing the gas, which becomes even __________.

colder  gas  heat
liquid  warmer  work

ANALYZE IT

A refrigerator is a device that causes heat to flow from a cool object (such as a pitcher of water) to a warm object (the air in the kitchen). Explain why this does not violate the second law of thermodynamics.
Directions: Answer the following questions about the heating system represented in the flowchart.

A. Furnace heats water to a boil.

B. Steam provided by boiling water travels through pipes to a radiator.

C. Steam cools inside radiator and condenses to water.

D. Thermal energy of heated radiator heats air in room.

1. Is the system in the flowchart a hot-water system or a steam-heating system?

2. How does the furnace get the energy needed to heat the water?

3. Is the furnace an internal or external combustion engine?

4. How is the thermal energy produced by the furnace transferred to the water?

5. Why do the pipes carrying the steam to the radiator need to be insulated?

6. How is the thermal energy from the steam transferred to the radiator?

7. How is the thermal energy of the radiator transferred to the surrounding air?

8. What happens to the steam as it gives up thermal energy inside the radiator?

9. How is heat from the air surrounding the radiator transferred to the air in the rest of the room?
Tie It Together

Thermal Energy

Use your knowledge of thermal energy to create an imaginative thermal energy conservation poster. Include conservation ideas for home, work and school. Use bubble captions to describe how thermal energy is conserved for each conservation method.
Thermal Energy  Chapter Wrap-Up

In the left column, copy the questions you listed in the Chapter Preview. In the right column, write down the answers you discovered as you worked through the chapter.

<table>
<thead>
<tr>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I wanted to find out</td>
<td>What I learned</td>
</tr>
</tbody>
</table>

Compare your previous answers to these.

Review

*Use this checklist to help you study.*

☐ Review the information you included in your Foldable.

☐ Study your *Science Notebook* on this chapter.

☐ Study the definitions of vocabulary words.

☐ Review daily homework assignments.

☐ Re-read the chapter and review the charts, graphs, and illustrations.

☐ Review the Self Check at the end of each section.

☐ Look over the Chapter Review at the end of the chapter.

**Summarize It**

After reading this chapter, list three things you have learned about thermal energy.

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68  *Thermal Energy*
Thermal Energy
How do the insulation properties of various materials compare?

Thermal energy travels as heat from a material at higher temperature to a material at lower temperature. Thermal energy can be transferred by conduction, convection, and radiation. Good conductors are materials that allow heat to move easily through them.

Good insulators, such as wood, glass, and fiberglass, do not allow heat to move easily through them. Buildings are insulated to keep them warm in winter and cool in summer. In cold weather, heat in a building flows to the outside, which is colder. Insulation reduces the amount of heat lost in this way.

In the Virtual Lab, you will make a hypothesis about which insulator best holds heat inside a house. You will then test each insulator and analyze your data to determine whether your hypothesis is correct. Use your Journal to record your procedure.

Objectives:
• Explain how insulation affects the transfer of energy.

• Compare the properties of insulating materials.

• Interpret a graph.

Procedure:
1. Decide which three of the materials you will use to insulate a house. State a problem in your Journal.

2. Make a hypothesis about which of the three insulation materials will best insulate a house in winter. State your hypothesis in your Journal.

3. Test your hypothesis. Drag an insulation material to the wall between the inside and the outside of the house. Click the Go button. Record the 12 A.M. temperature in the appropriate column in the Table. Test the material by recording the indoor temperature, in degrees Celsius, every two hours, in the appropriate place in the Table. Click the Graph button to see a different representation of your data.

4. Test the two other insulation materials and record data in the same way.

5. Analyze the results of your experiment in your Journal.

6. Determine whether your hypothesis is correct. Record your conclusions in your Journal.
Module 6 Exam: Heat

True/False
Indicate whether the statement is true or false.

____ 1. In an internal combustion engine, fuel burns outside the engine in chambers called cylinders.

____ 2. Solar energy can be changed into thermal energy without any work being done.

____ 3. Winds are examples of convection currents.

____ 4. Shiny materials absorb radiant energy.

____ 5. Heat is a measure of the average kinetic energy of all the particles in an object.

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 6. A material that reduces the flow of heat by conduction, convection, and radiation is ____.
   a. a conductor
   b. condensation
   c. an insulator
   d. a solar collector

____ 7. All of the following are good conductors of heat EXCEPT ____.
   a. air
   b. aluminum
   c. copper
   d. silver

____ 8. The transfer of energy that does NOT require matter is ____.
   a. combustion
   b. radiation
   c. conduction
   d. convection

____ 9. Energy from the Sun travels to Earth as ____.
   a. chemical energy
   b. combustion
   c. radiant energy
   d. mechanical energy

____ 10. Solar collectors are parts of a(n) ____.
    a. active solar heating system
    b. external combustion engine
    c. radiant heating system
    d. passive solar heating system

____ 11. Refrigerators and air conditioners are examples of ____.
    a. heat engines
    b. heat movers
    c. heat pumps
    d. solar collectors

____ 12. The process by which engine fuels burn is called ____.
    a. combustion
    b. condensation
    c. conduction
    d. convection
13. Gasoline engines and diesel engines are _____.
   a. insulators
   b. external combustion engines
   c. internal combustion engines
   d. heat movers

14. A device that heats your home by removing thermal energy from one location and transferring it to another location at a different temperature is a(n) _____.
   a. conductor
   b. internal combustion engine
   c. heat engine
   d. heat mover

15. A device that converts thermal energy into mechanical energy is a _____.
   a. conductor
   b. refrigerator
   c. heat engine
   d. heat mover

Matching

*Match each item with the correct statement below. Some items may be used more than once.*

a. forced air
b. passive solar
c. radiator
d. active solar
e. electric heating system

16. large windows on south side of building

17. large tank for storing water heated by the Sun and pumps to move the water

18. heated coils in ceilings and floors heat the surrounding air by conduction

19. a closed metal container containing hot water or steam

20. most common type of heating system

Completion

*Complete each statement.*

21. Liquids and gases are different from solids because they ____________________.

22. Good ____________________ do not allow heat to move easily through them.

23. ____________________ is the total energy of the molecules in a material.

24. Specific heat is the amount of ____________________ required to raise the temperature of 1 kg of a material 1 K.
25. In Figure 6-1, room A, the heat from the pot on the stove moves to the pot's handle by ____________.

**Short Answer**

26. Explain how a cooking pan can be made entirely of glass and transfer heat without overheating the handle.