Thermal Energy

Using Thermal Energy

Before You Read

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you’ve read this lesson, reread the statements to see if you have changed your mind.

<table>
<thead>
<tr>
<th>Before</th>
<th>Statement</th>
<th>After</th>
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</thead>
<tbody>
<tr>
<td>5.</td>
<td>Car engines create energy.</td>
<td></td>
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<tr>
<td>6.</td>
<td>Refrigerators cool food by moving thermal energy from inside the refrigerator to the outside.</td>
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Read to Learn

Thermal Energy Transformations

Burning wood heats the air. A toaster gets hot when you turn it on. You can convert other forms of energy into thermal energy. You also can convert thermal energy into other forms of energy. Thermostats switch heaters on and off, transforming thermal energy into mechanical energy. When you convert energy from one form to another, you can use the energy to perform useful tasks. Energy cannot be created or destroyed. Many devices transform energy from one form to another or transfer energy from one place to another. However, the total amount of energy does not change.

Heating Appliances

A device that converts electric energy into thermal energy is a heating appliances. Curling irons and coffeemakers are heating appliances. Computers and cell phones also become warm when you use them. This is because some electric energy always converts to thermal energy in an electronic device. However, the thermal energy that most electronic devices generate is not used for any purpose.

Thermostats

A thermostat is a device that regulates the temperature of a system. Refrigerators, toasters, and ovens have thermostats.

Key Concepts

- How does a thermostat work?
- How does a refrigerator keep food cold?
- What are the energy transformations in a car engine?

Identify the Main Ideas

Write a phrase beside each paragraph that summarizes the main point of the paragraph. Use the phrases to review the lesson.

Make a four-tab book to explain the energy transformation that occurs in each device.

Thermal Energy
**Turning a Furnace Off** Most thermostats in home heating systems contain a bimetallic coil. A bimetallic coil is made of two types of metal that are joined together and bent into a coil. The metal on the inside of the coil expands and contracts more with changes in temperature than the metal on the outside of the coil. After a room warms, the thermal energy in the air causes the bimetallic coil to uncurl slightly. This tilts a switch that turns off the furnace.

**Turning a Furnace On** As the air in the room cools, the metal on the inside of the coil contracts more than the metal on the outside. This curls the coil tighter, which tilts the switch in the other direction, turning on the furnace.

**Refrigerators**

A device that uses electric energy to transfer thermal energy from a cooler location to a warmer location is called a refrigerator. Recall that thermal energy naturally flows from a warmer area to a cooler area. A refrigerator does the opposite. It moves thermal energy from from its cold inside to the warm air outside. As shown below, pipes that surround the refrigerator are filled with a fluid, called a coolant, that flows through the pipes. Thermal energy inside the refrigerator transfers to the coolant, keeping the inside of the refrigerator cold.

**Vaporizing the Coolant**

A coolant is a substance that evaporates at a low temperature. A coolant is pumped through the pipes inside and outside of the refrigerator. The coolant, which begins as a liquid, passes through an expansion valve and cools. The cold gas flows through pipes inside the refrigerator, absorbs thermal energy, and vaporizes. The coolant gas becomes warmer, and the inside of the refrigerator becomes cooler.
Condensing the Coolant

The coolant flows to an electric compressor. Here, the coolant is compressed, or forced into a smaller space, which increases its thermal energy. Then, the gas is pumped through condenser coils. There, the thermal energy of the gas is greater than that of the surrounding air. This causes thermal energy to flow from the coolant gas to the air. As thermal energy is removed from the gas, it condenses, or becomes a liquid. The liquid coolant is pumped up through the expansion valve. The cycle repeats.

Heat Engines

A car engine is a heat engine. A heat engine is a machine that converts thermal energy into mechanical energy. This mechanical energy then moves the car. Most vehicles use a type of heat engine called an internal combustion engine. The figure below shows how one type of internal combustion engine converts thermal energy into mechanical energy.

A cylinder is a tube with a piston that moves up and down. At one end of the cylinder, a spark ignites a fuel-air mixture. The ignited mixture expands and pushes the piston down. The fuel's chemical energy converts to thermal energy and some of the thermal energy immediately converts to mechanical energy. A heat engine is not efficient. Most car engines convert only about 20 percent of the chemical energy in gasoline into mechanical energy. The remaining energy from the gasoline is lost to the environment.

Key Concept Check
4. Identify What is one form of energy that is output from a heat engine?

Visual Check
5. State What device ignites the fuel-air mixture in an internal combustion engine?

Internal Combustion Engine

1. The intake valve opens as the piston moves downward, drawing a mixture of gasoline and air into the cylinder.
2. The intake valve closes as the piston moves upward, compressing the fuel-air mixture.
3. A spark plug ignites the fuel-air mixture. As the mixture burns, hot gases expand, pushing the piston down.
4. As the piston moves up, the exhaust valve opens, and the hot gases are pushed out of the cylinder.
Mini Glossary

heat engine: a machine that converts thermal energy into mechanical energy

refrigerator: a device that uses electric energy to transfer thermal energy from a cooler location to a warmer location

heating appliance: a device that converts electric energy into thermal energy

thermostat: a device that regulates the temperature of a system

1. Review the terms and their definitions in the Mini Glossary. Write a sentence explaining how a refrigerator keeps food cold.

2. Complete the graphic organizer to show the types of energy a heat engine converts and produces.

<table>
<thead>
<tr>
<th>Converts</th>
<th>Heat engine</th>
<th>Produces</th>
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<tbody>
<tr>
<td></td>
<td>94% efficient</td>
<td></td>
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</table>

3. You use some logs to build a campfire. Have you created energy? Destroyed energy? Explain your answer.

   | You use some logs to build a campfire. Have you created energy? Destroyed energy? Explain your answer. |