How to Use This Presentation

- To View the presentation as a slideshow with effects select "View" on the menu bar and click on "Slide Show."
- To advance through the presentation, click the right-arrow key or the space bar.
- From the resources slide, click on any resource to see a presentation for that resource.
- From the Chapter menu screen click on any lesson to go directly to that lesson's presentation.
- You may exit the slide show at any time by pressing the Esc key.

End Of Slide

Chapter menu | Resources

Resources

Chapter Presentation

Image and Activity Bank

Transparencies

Standardized Test Prep

Table of Contents

End Of Slide

Objectives

- **List** six forms of renewable energy, and compare their advantages and disadvantages.
- **Describe** the difference between passive solar heating, active solar heating, and photovoltaic energy.
- **Describe** the current state of wind energy technology.
- **Explain** the differences in biomass fuel use between developed and developing nations.
- **Describe** how hydroelectric energy, geothermal energy, and geothermal heat pumps work.

End Of Slide

Renewable Energy

- **Renewable energy** is energy from sources that are constantly being formed.

- Types of renewable energy includes:
  - solar energy
  - wind energy
  - the power of moving water
  - Earth's heat.

- Remember, all sources of energy, including renewable sources, affects the environment.

End Of Slide

Solar Energy—Power from the Sun

- Nearly all renewable energy comes directly or indirectly from the sun.
- Direct solar energy is used every day, like when the sun shines on a window and heats the room.
- Solar energy can also be used indirectly to generate electricity in solar cells.

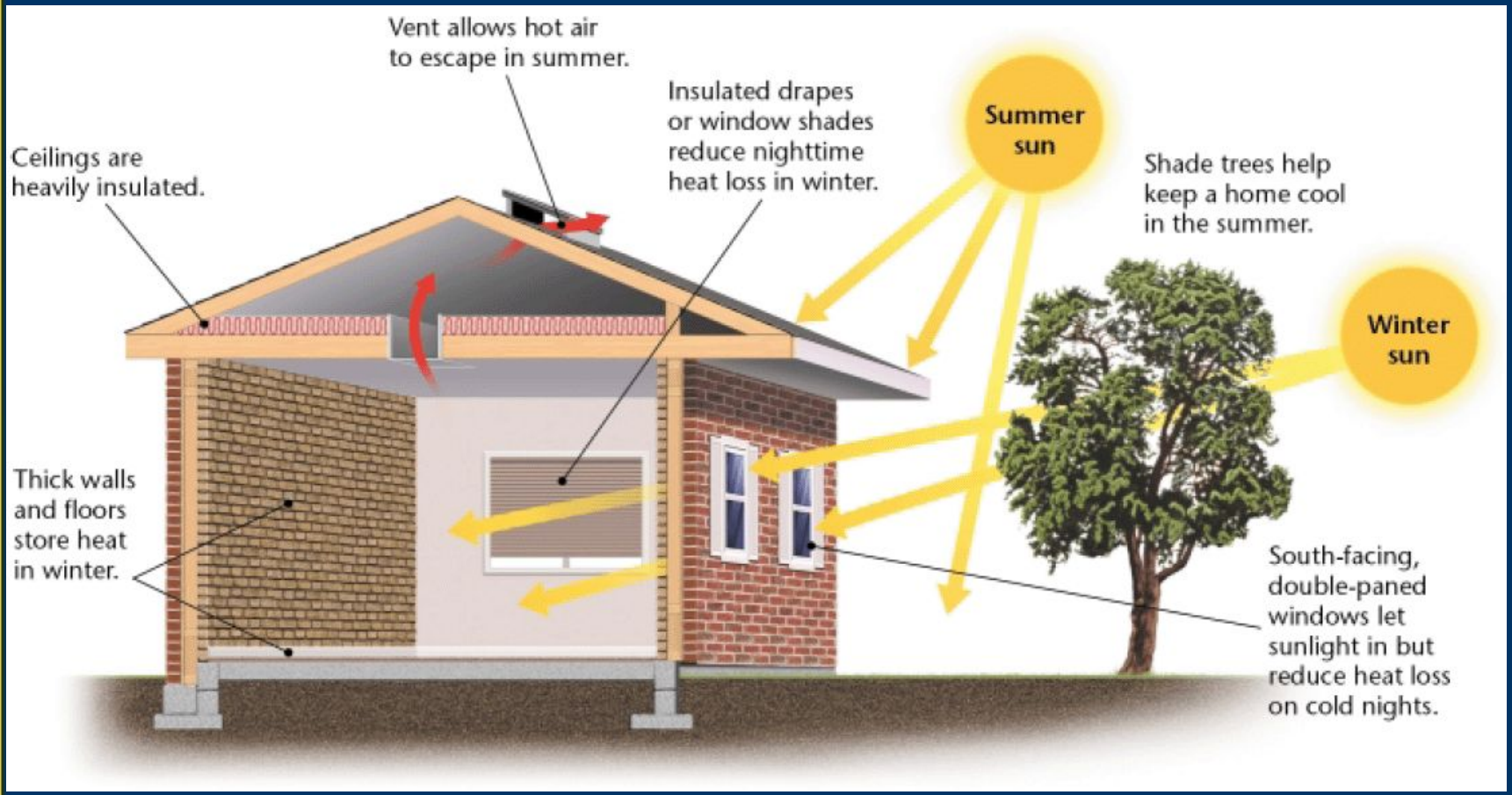
End Of Slide

Passive Solar Heating

- **Passive solar heating** is the use of sunlight to heat buildings directly.
- In the Northern Hemisphere, south facing windows receive the most solar energy.
- Therefore, passive solar buildings have large windows that face south.
- An average household could reduce its energy bills by using any of the passive solar features shown on the next slide.

End Of Slide
Chapter menu
Resources

Passive Solar Heating

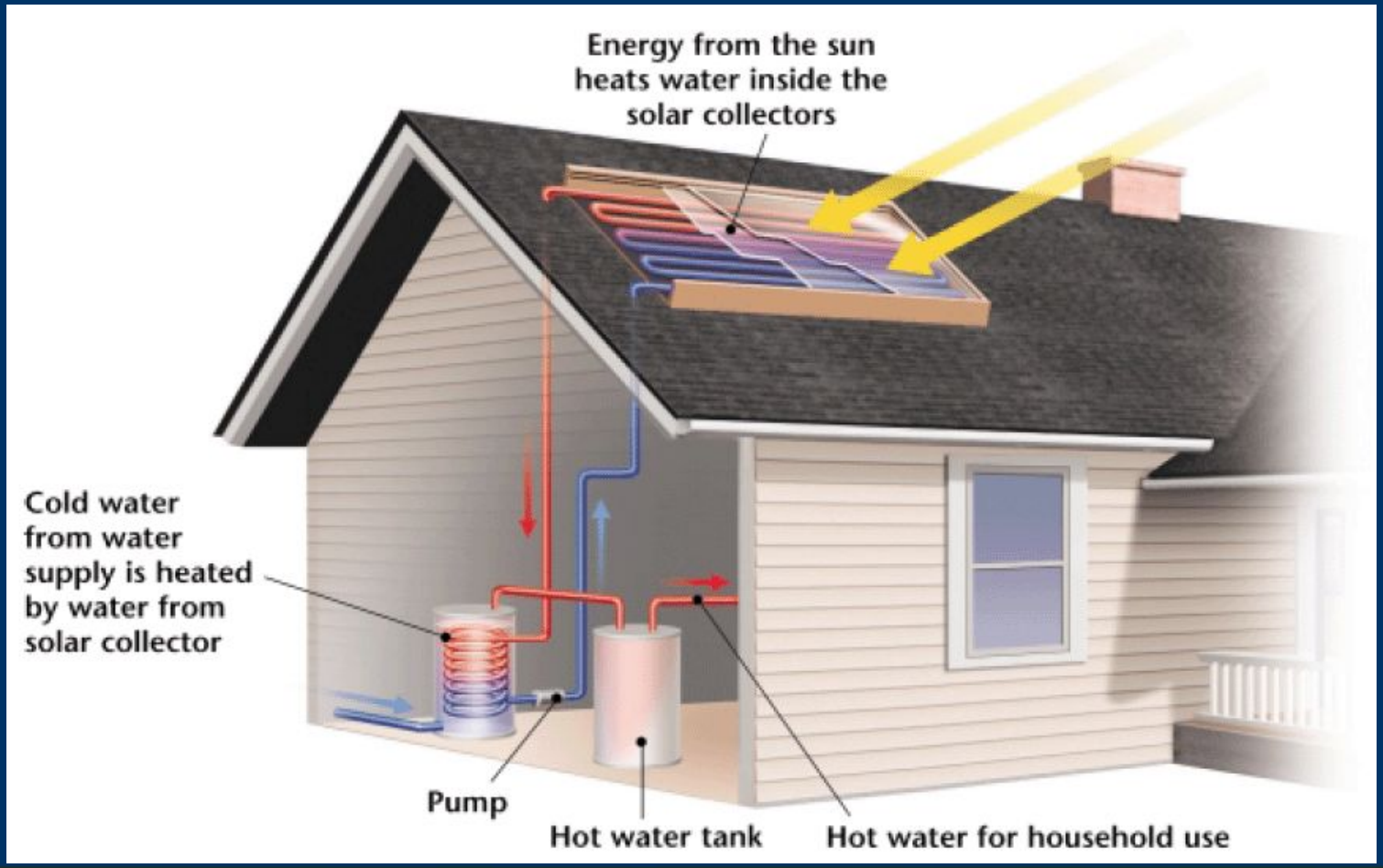


Active Solar Heating

- **Active solar heating** is the gathering of solar energy by collectors that are used to heat water or heat a building.
- More than 1 million homes in the United States use active solar energy to heat water.
- Solar collectors, usually mounted on a roof, capture the sun's energy.

End Of Slide
Chapter menu
Resources

Active Solar Heating



Active Solar Heating

- A liquid is heated by the sun as it flows through solar collectors.
- The hot liquid is then pumped through heat exchangers, which heats water for the building.
- About 8% of the energy used in the United States is used to heat water; therefore, active solar technology could save a lot of energy.

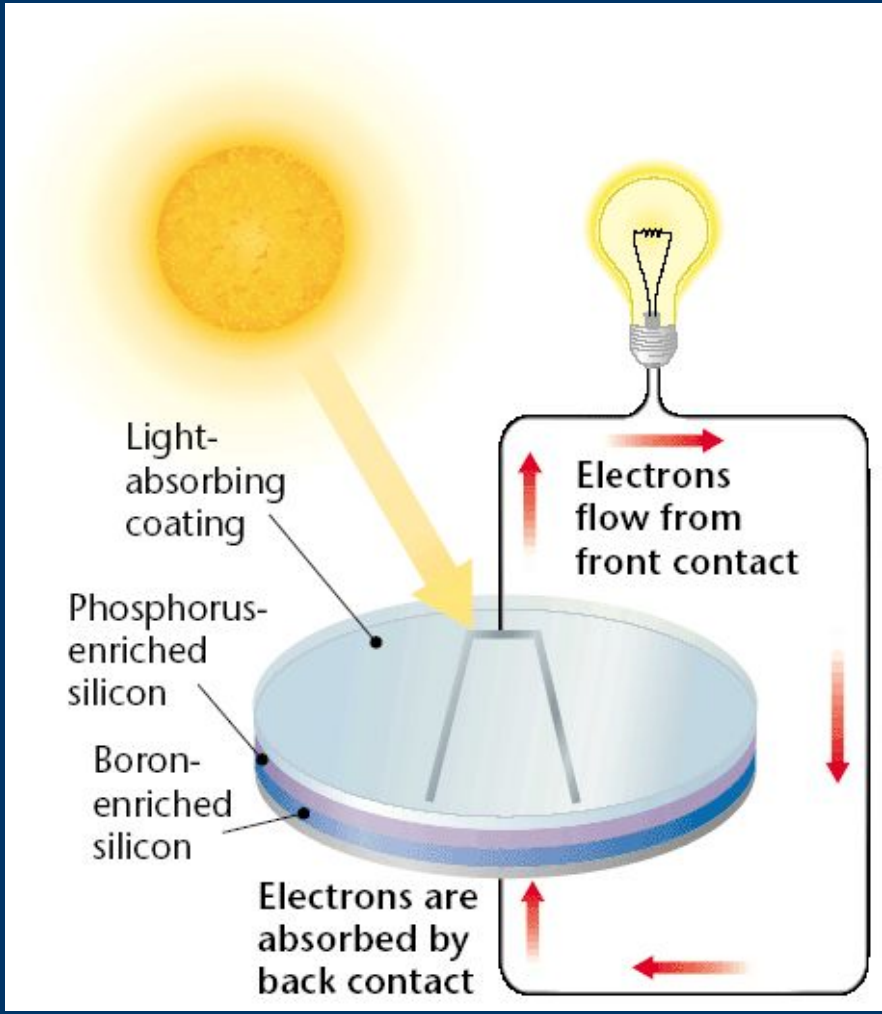
End Of Slide

Photovoltaic Cells

- **Photovoltaic cells** are solar cells that convert the sun's energy into electricity.
- Solar cells have no moving parts, and they run on nonpolluting power from the sun.
- However, they produce a very small electrical current. Meeting the electricity needs of a small city would require covering hundreds of acres with solar panels.

Photovoltaic Cells

Sunlight falls on a semiconductor, causing it to release electrons. The electrons flow through a circuit that is complete when another semiconductor in the solar cell absorbs electrons and passes them on to the first semiconductor



Photovoltaic Cells

- Solar cells require extended periods of sunshine to produce electricity. This energy is stored in batteries, which supplies electricity when the sun is not shining.
- Currently, solar cells provide energy for more than 1 million households in developing countries, where energy consumption is minimal and electricity distribution networks are limited.

End Of Slide

Wind Power

- Energy from the sun warms the Earth's surface unevenly, which causes air masses to flow in the atmosphere.
- We experience the movement of these air masses as wind.
- Wind power, which converts the movement of wind into electric energy, is the fastest growing energy source in the world.

End Of Slide

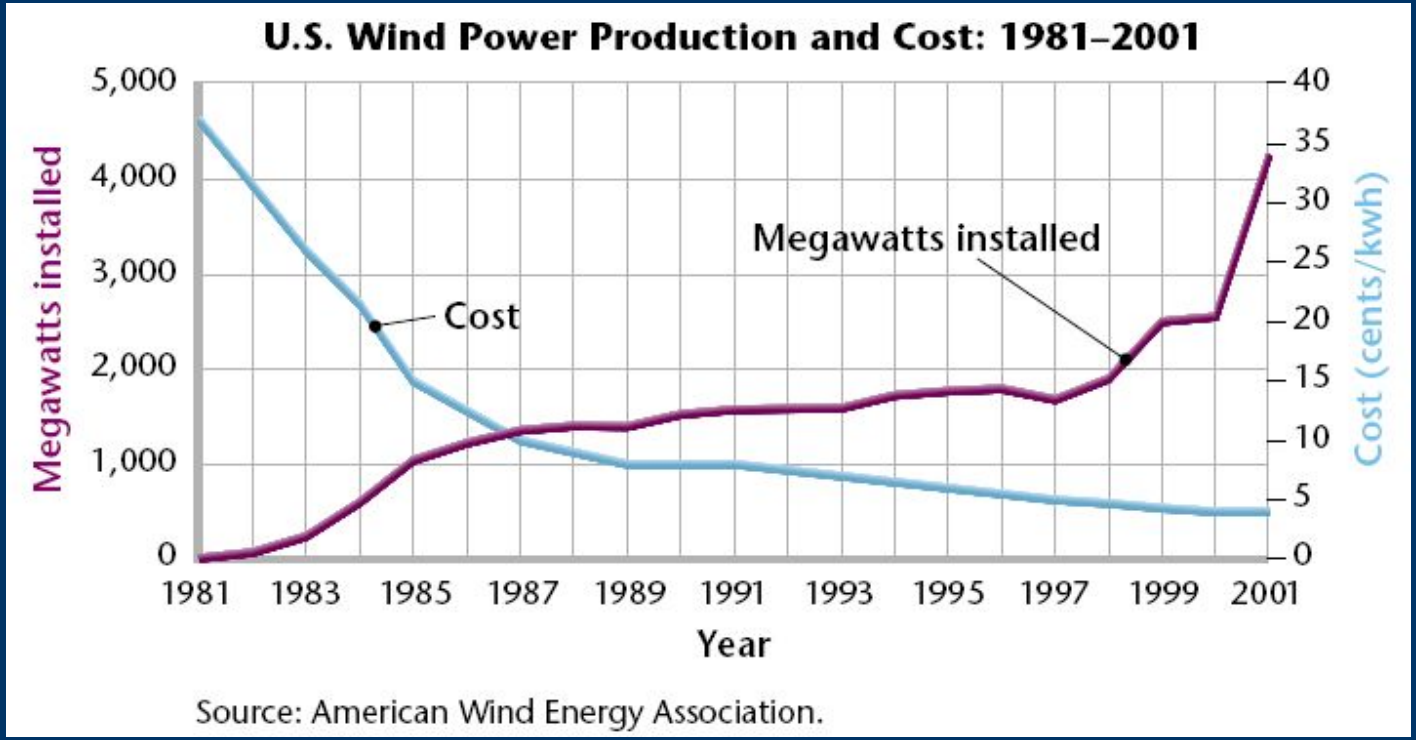
Wind Farms

- Wind turbines are used to capture the energy from the wind.
- Large arrays of wind turbines are called **wind farms**. Large wind farms supply electricity to thousands of homes.
- In windy rural areas, small wind farms with 20 or fewer turbines are also becoming common.
- Because wind turbines take up little space, some farmers can add wind turbines to their land and still use the land for other purposes.

End Of Slide

Wind Farms

- The cost of wind power has been steadily falling as wind turbines have become more efficient.



End Of Slide

An Underdeveloped Resource

- Scientists estimate that the windiest spots on Earth could generate more than ten times the energy used worldwide.
- In the future, the electricity may be used on the wind farm to produce hydrogen from water.
- Today, all of the large energy companies are developing plans to use more wind power.

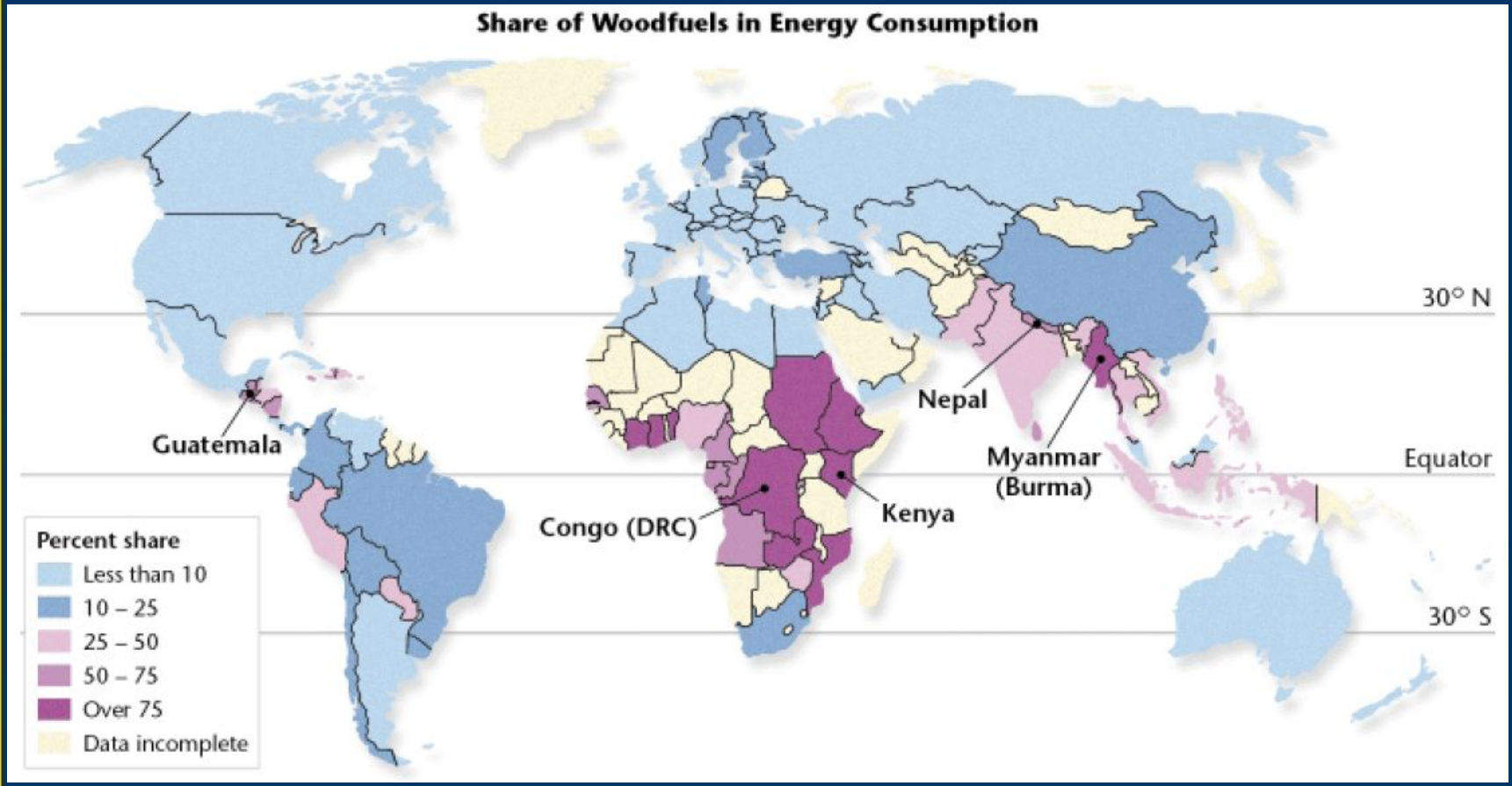
End Of Slide

Biomass—Power from Living Things

- **Biomass fuel** consists of plant material, manure, or any other organic matter that is used as an energy source.
- Fossil fuels can be thought of as biomass energy sources, although they are nonrenewable.
- Renewable biomass fuels, such as wood and dung, are major sources of energy in developing countries.
- More than half of all wood cut in the world is used as fuel for heating and cooking.

End Of Slide

Biomass—Power from Living Things



Biomass—Power from Living Things

- Although materials like wood are a renewable resource, if trees are cut down faster than they grow, the resulting habitat loss, deforestation, and soil erosion can be severe.
- In addition, harmful air pollution may result from burning wood and dung.

Methane

- When bacteria decompose organic wastes, one byproduct is methane gas.
- Methane can be burned to generate heat or electricity.
- In China, more than 6 million households use biogas digesters to ferment manure and produce gas for heating and cooking.
- Some landfills in the United States generate electricity by using the methane from the decomposition of trash.

End Of Slide

Alcohol

- Liquid fuels can also be derived from biomass.
- For example, ethanol, an alcohol, can be made by fermenting fruit or agricultural waste. In the United States, corn is a major source of ethanol.
- Cars and trucks can run on ethanol or **gasohol**, a blend of gasoline and ethanol. Gasohol produces less air pollution than fossil fuels.
- Some states require the use of gasohol in vehicles as a way to reduce air pollution.

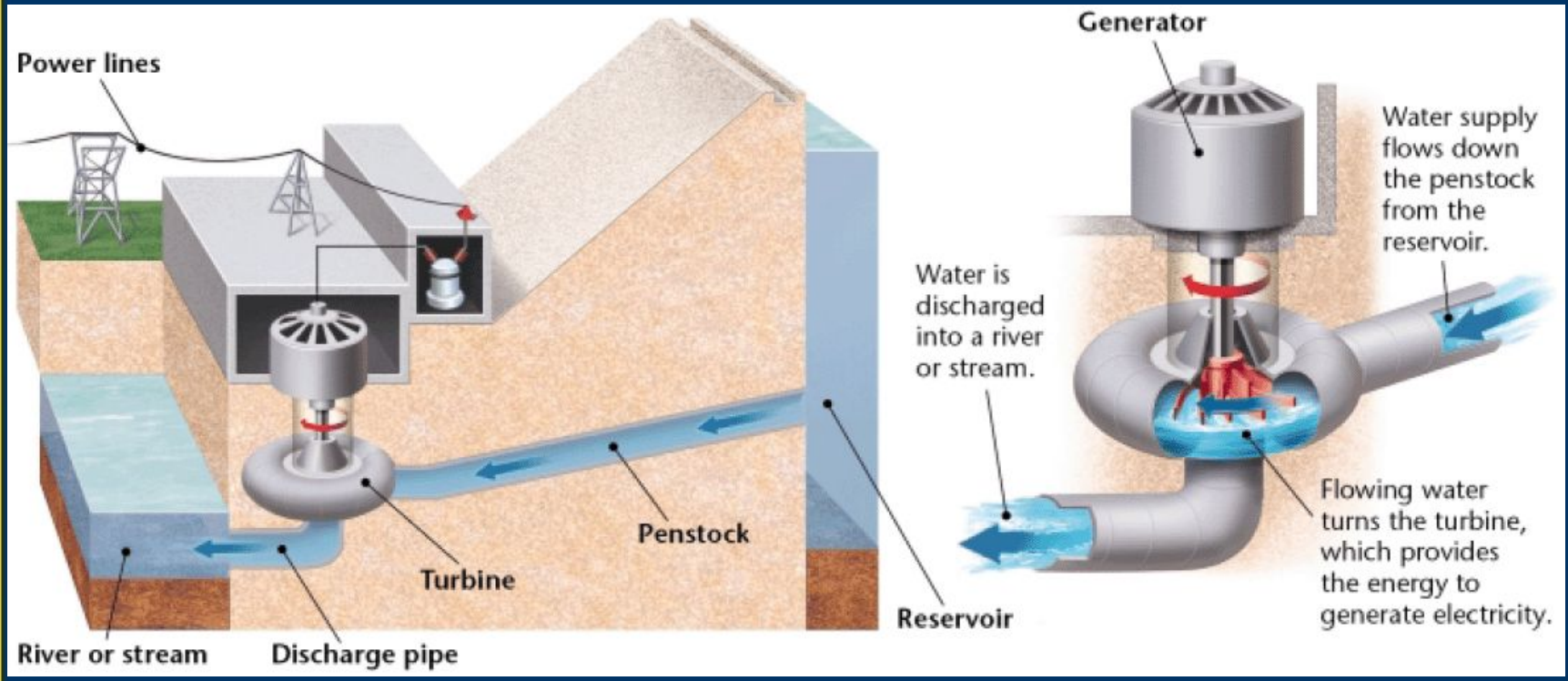
End Of Slide

Hydroelectricity—Power from Moving Water

- **Hydroelectric energy** is electrical energy produced by falling water.
- Hydroelectric energy accounts for 20% of the world's electricity.
- Large hydroelectric power plants have a dam that is built across a river to hold back a reservoir of water.
- The water in the reservoir is released to turn a turbine, which generates electricity.

End Of Slide

Hydroelectricity—Power from Moving Water



The Benefits of Hydroelectric Energy

- Hydroelectric dams are expensive to build, but relatively inexpensive to operate.
- Unlike fossil fuel plants, hydroelectric dams do not release air pollutants that cause acid precipitation.
- Hydroelectric dams also tend to last much longer than fossil fuel-powered plants.
- Dams also provide other benefits such as flood control and water for drinking, agriculture, industry, and recreation.

End Of Slide
Chapter menu
Resources

Disadvantages of Hydroelectric Energy

- A dam changes a river's flow, which can have far-reaching consequences.
- A reservoir floods large areas of habitat above the dam. Water flow below the dam is reduced, which disrupts ecosystems downstream.
- For example, many salmon fisheries of the northwestern United States have been destroyed by dams that prevent salmon from swimming upriver to spawn.

End Of Slide

Disadvantages of Hydroelectric Energy

- When the land behind a dam is flooded, people are often displaced. If a dam bursts, people living in areas below the dam can be killed.
- River sediments build up behind the dam instead of enriching land farther down the river, making farmland below the dam less productive.
- Recent research has also shown that the decay of plant matter trapped in reservoirs can release large amounts of greenhouse gases—sometimes more than a fossil-fuel powered plant.

End Of Slide

Modern Trends

- While in developing countries the construction of large dams continues, in the United States, the era of large dam construction is probably over.
- One modern trend is **micro-hydropower**, which is electricity produced in a small stream without having to build a big dam. The turbine may even float in the water, not blocking the river at all.
- Micro-hydropower is much cheaper than large hydroelectric dam projects, and it permits energy to be generated from small streams in remote areas.

End Of Slide

Geothermal Energy—Power from the Earth

- In some areas, deposits of water in the Earth's crust are heated by geothermal energy.
- **Geothermal energy** is the energy produced by heat within the Earth.
- The United States is the world's largest producer of geothermal energy.
- Although geothermal energy is considered a renewable resource, the water that is used must be managed carefully so that it is not depleted.

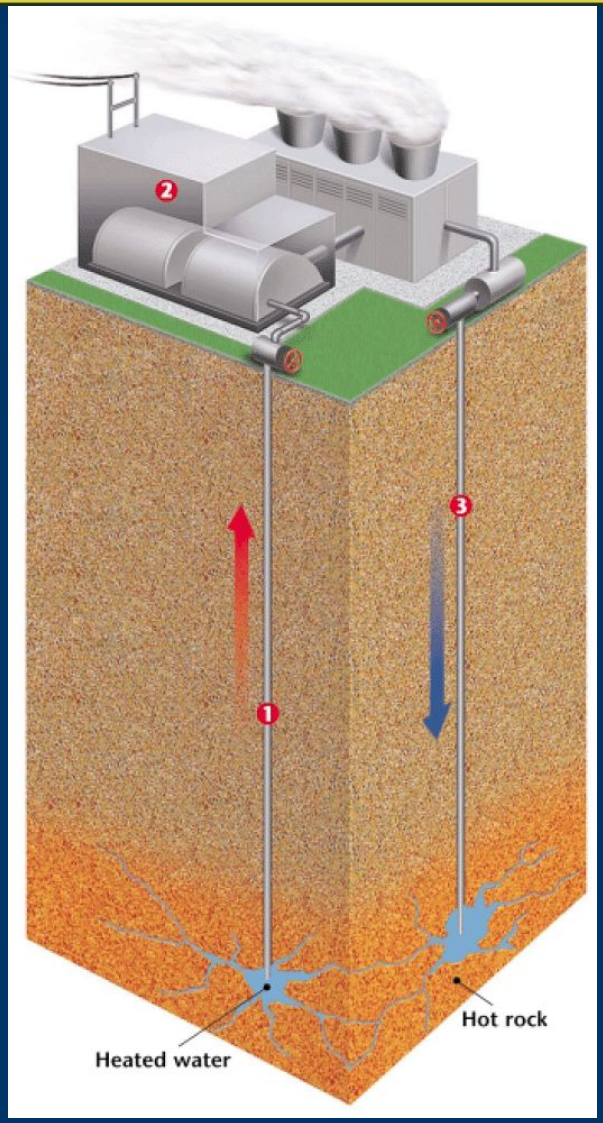
End Of Slide

Geothermal Energy—Power from the Earth

- Geothermal power plants generate electricity using the following steps
  - Steam rises through a well
  - Steam drives turbines, which generate electricity
  - Leftover liquid is pumped back into the hot rock
- The leftover liquid, water, is returned to Earth's crust because it can be reheated by geothermal energy and used again.

End Of Slide

Geothermal Energy—Power from the Earth

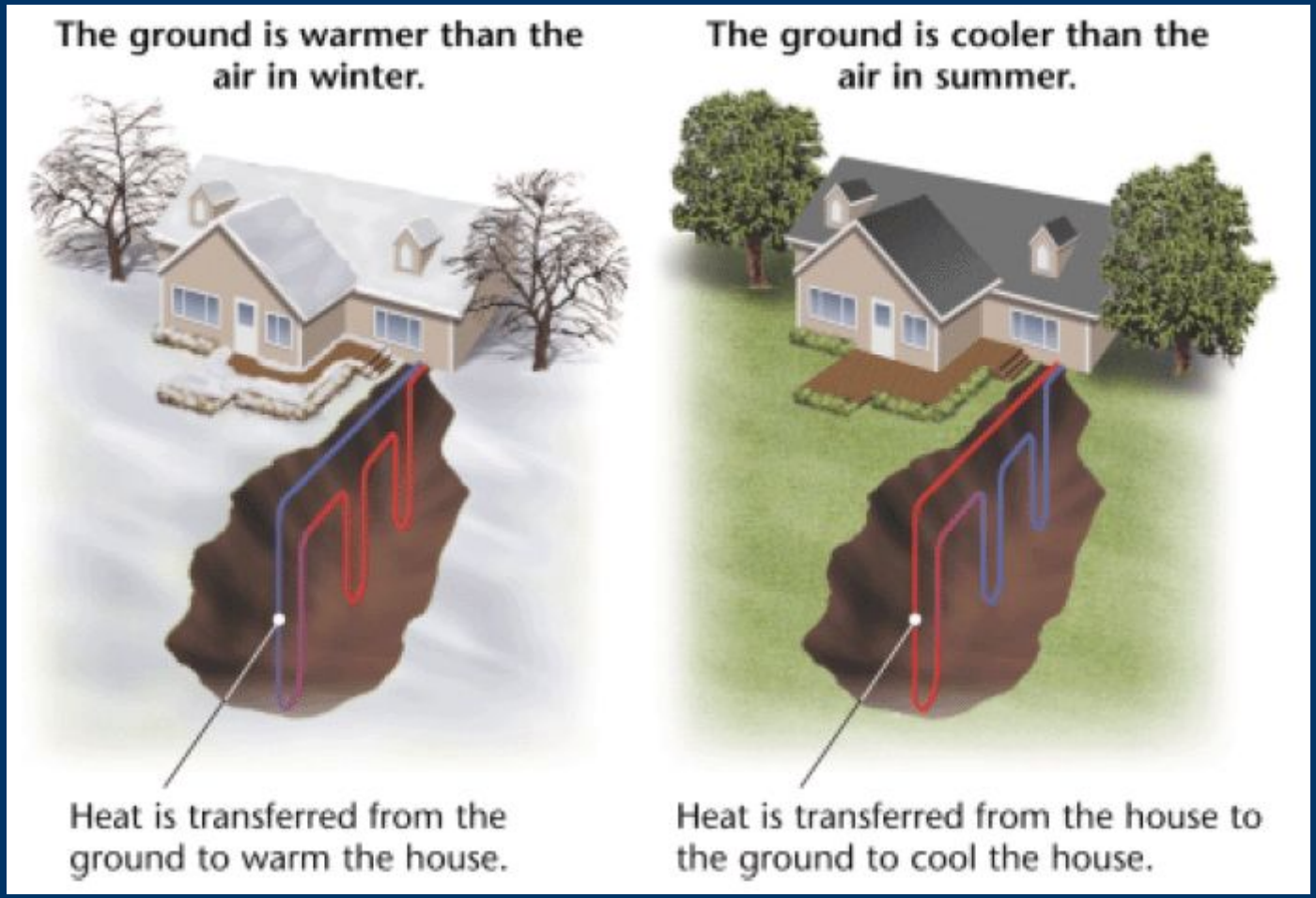


Geothermal Heat Pumps: Energy for Homes

- More than 600,000 homes in the United States are heated and cooled using geothermal heat pumps.
- A **geothermal heat pump** uses stable underground temperatures to warm and cool homes because the temperature of the ground is nearly constant year-round.
- A heat pump is simply a loop of piping that circulates a fluid underground.

End Of Slide

Geothermal Heat Pumps: Energy for Homes



Geothermal Heat Pumps: Energy for Homes

- In the summer, the ground is cooler than air and the fluid cools the home.
- In the winter, the ground is warmer than air, and the fluid warms the home.

End Of Slide

Objectives

- **Describe** three alternative energy technologies.
- **Identify** two ways that hydrogen could be used a fuel source in the future.
- **Explain** the difference between energy efficiency and energy conservation.
- **Describe** two forms of energy-efficient transportation.
- **Identify** three ways that you can conserve energy in your daily life.

End Of Slide

Alternative Energy

- To achieve a future where energy use is sustainable, we must make the most of the energy sources we already have and develop new sources of energy.
- **Alternative energy** describes energy that does not come from fossil fuels and that is still in development.

End Of Slide
Chapter menu
Resources

Alternative Energy

- For an alternative energy source to become a viable option for the future, the source must be proven to be cost effective.
- Also, the environmental effects of using the energy source must be acceptable.

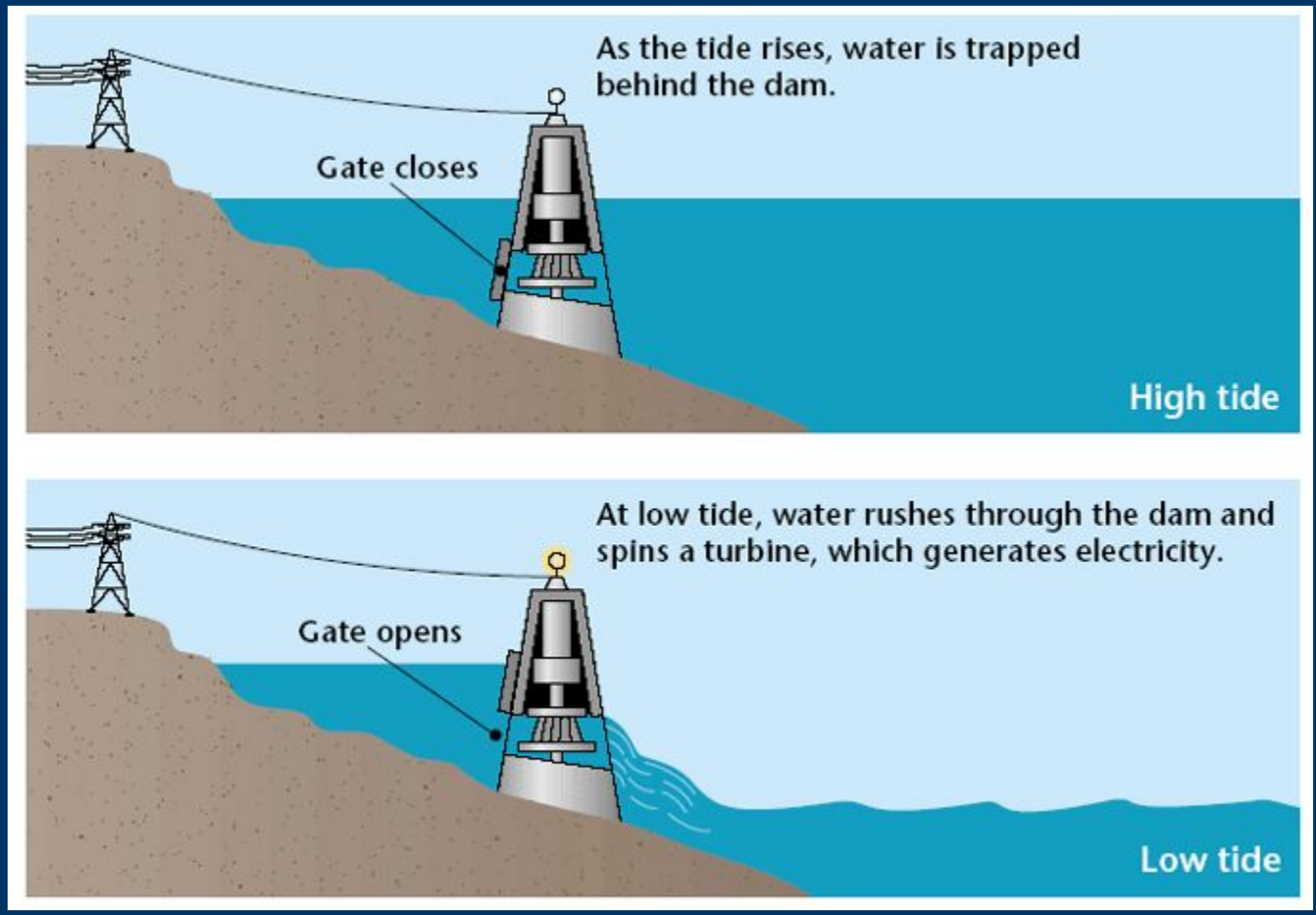
End Of Slide

Tidal Power

- A tidal power plant works much like a hydroelectric dam.
- As the tide rises, water enters a bay behind a dam. The gate then closes at high tide.
- At low tide, the gate opens and the water in the bay rushes through, spinning a turbine that generates electricity.

End Of Slide

Tidal Power



Tidal Power

- Although tidal energy is renewable and nonpolluting, it will not become a major energy source in the future.
- The cost of building and maintaining tidal power plants is high, and there are few suitable locations.

End Of Slide

Ocean Thermal Energy Conservation

- In the tropics, the temperature difference between the surface of the ocean and the deep ocean waters can be as much as 24ºC (43ºF).
- **Ocean thermal energy conservation (OTEC)** is the use of temperature differences in ocean water to produce electricity.

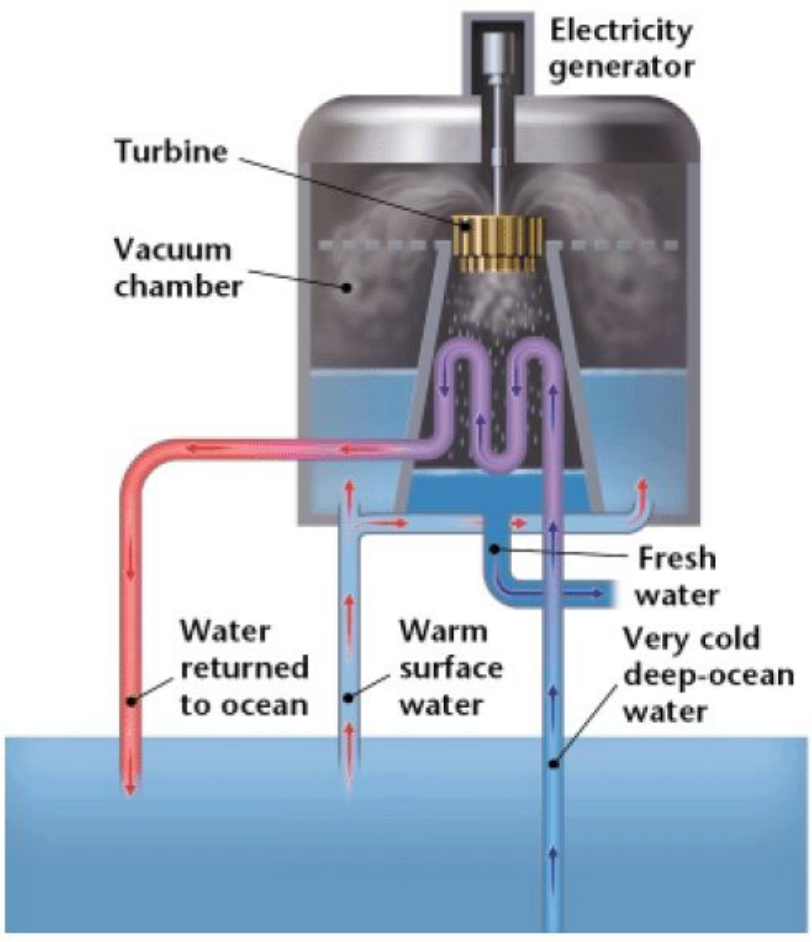
End Of Slide
Chapter menu
Resources

Ocean Thermal Energy Conservation

- An OTEC plant produces energy using the following steps
  - Warm surface water is boiled in a vacuum chamber.
  - This produces a steam that drives a turbine to generate electricity.
  - Cold deep-ocean water will condense the steam.
  - The steam turns into water that can be used again.

End Of Slide

Ocean Thermal Energy Conservation



Ocean Thermal Energy Conservation

- The United States and Japan have experimented with OTEC power, but so far, no project has been able to generate electricity cost effective.
- OTEC plants are inefficient because about one-third of the electricity the plant produces is used to pump cold water up from the deep ocean.
- The environmental effects of pumping large amounts of cold water to the surface are also unknown.

End Of Slide

Hydrogen—A Future Fuel Source?

- Hydrogen, the most abundant element in the universe, can be burned as a fuel.
- Hydrogen does not contain carbon, so it does not release pollutants associated with burning fossil fuels and biomass.
- When hydrogen is burned in the atmosphere, it combines with oxygen to produce water vapor, a harmless byproduct, and small amounts of nitrogen oxides.

End Of Slide

Hydrogen—A Future Fuel Source?

- Hydrogen gas (H_2) can be produced by using electricity to split molecules of water (H_2O).
- Hydrogen fuel can be made from any material that contains a lot of hydrogen.
- In the future, we may also be able to grow plants to produce hydrogen cost effectively.

End Of Slide

The Challenge of Hydrogen Fuel

- One difficulty of using hydrogen as a fuel today is that hydrogen takes a lot of energy to produce.
- If this energy came from burning fossil fuels, generating hydrogen would be expensive and polluting.

End Of Slide

The Challenge of Hydrogen Fuel

- One alternative is to use electricity from solar cells or wind power to split water molecules to produce hydrogen.
- Hydrogen could then be stored in pressurized tanks and transported in gas pipelines.
- Or hydrogen might not be stored at all—it might be used as it is produced, in fuel cells.

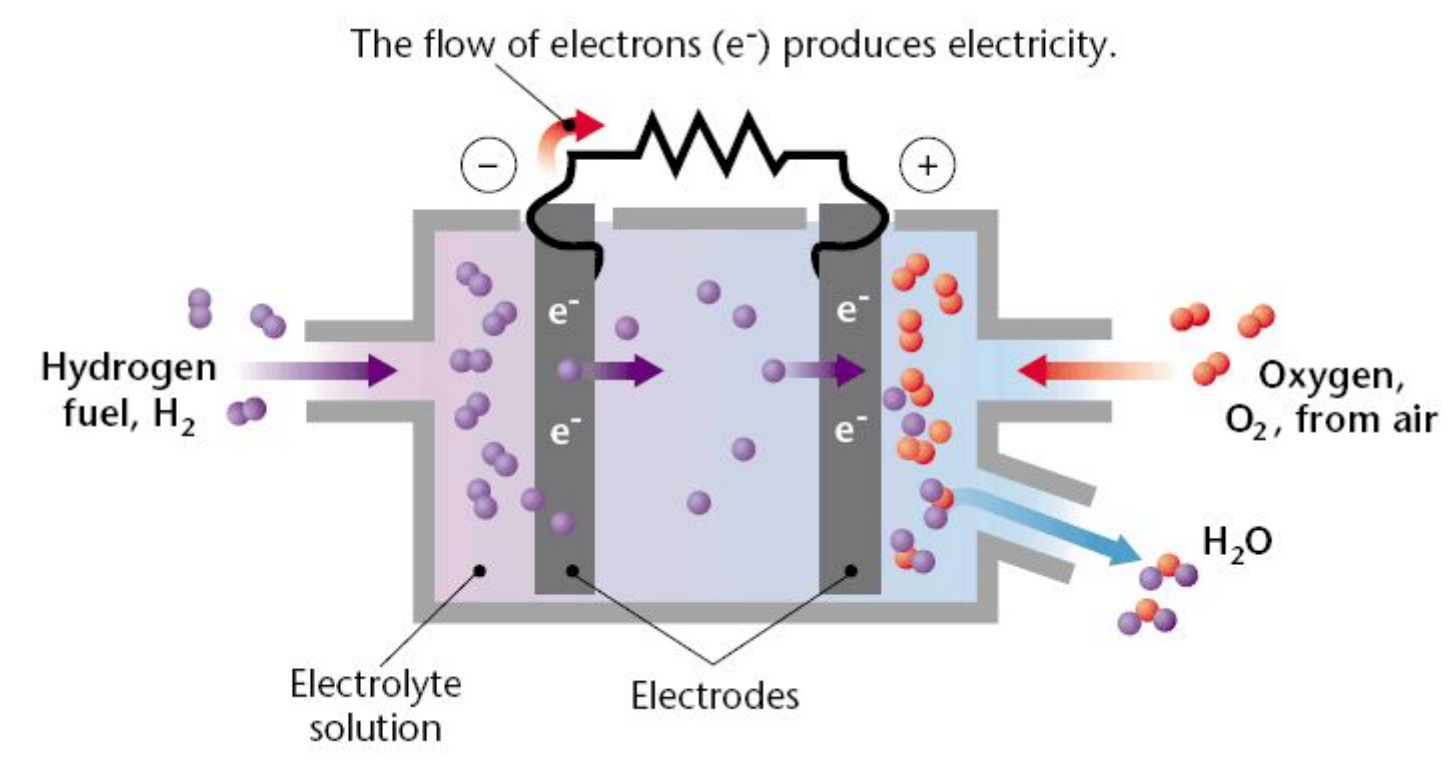
End Of Slide

Fuel Cells

- A **fuel cell** is a device that produces electricity chemically by combining hydrogen fuel with oxygen from the air.
- When hydrogen and oxygen are combined, electrical energy is produced and water is the only byproduct.
- Fuel cells can be fueled by anything that contains plenty of hydrogen, including natural gas, alcohol, or even gasoline.

End Of Slide

Fuel Cells



Energy Efficiency

- There are two main ways to reduce energy use:
  - lifestyle changes
  - increases in energy efficiency

- **Energy efficiency** is the percentage of energy put into a system that does useful work.

- Energy efficiency can be determined by this equation:

$$\text{energy efficiency (in \%)} = \text{energy out/energy in} \times 100$$

End Of Slide

Energy Efficiency

- Most of our devices are fairly inefficient. More than 40 percent of all commercial energy used in the United States is wasted.
- Increasing efficiency may involve sacrifices or investments in new technology.

Energy Efficiency of Common Conversion Devices

Device	Efficiency
Incandescent light bulb	5%
Fluorescent light bulb	22%
Internal combustion engine (gasoline)	10%
Human body	20%–25%
Steam turbine	45%
Fuel cell	60%

End Of Slide

Efficient Transportation

- Developing efficient engines to power vehicles and increasing the use of public transportation systems would help increase energy efficiency of American life.
- The internal combustion engines that power most vehicles do so inefficiently and produce air pollution.
- In the next 50 years, the design of these engines may change radically to meet the need for more efficient transportation.

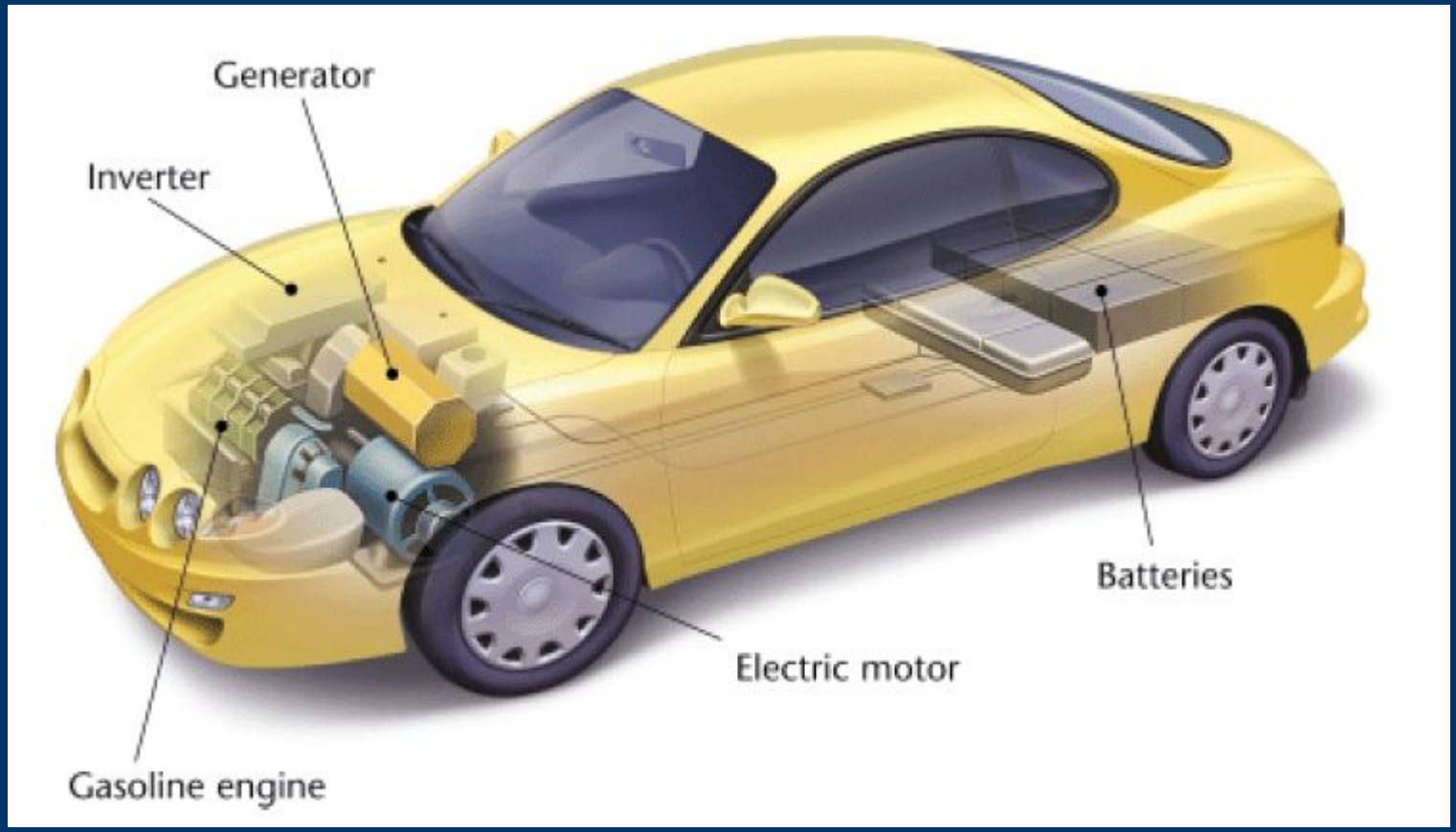
End Of Slide

Hybrid Cars

- Hybrid cars are examples of energy-efficient vehicles.
- Hybrid cars use small, efficient gasoline engines most of the time, but they also use electric motors when extra power is needed, such as while accelerating.
- Hybrid cars do not cost much more than conventional vehicles, they cost less to refuel, and they produce less harmful emissions.

End Of Slide

Hybrid Cars



Hybrid Cars

- Hybrid cars feature many efficient technologies.
  - They convert some energy of braking into electricity and store this energy in the battery.
  - The gasoline engine is sometimes shut off to save fuel, such as when the car is stopped at a red light.
  - They are aerodynamic in design and need less energy to accelerate.

End Of Slide

Cogeneration

- **Cogeneration** is the production of two useful forms of energy from the same fuel source.
- For example, the waste heat from an industrial furnace can power a steam turbine that produces electricity.
- Small cogeneration systems have been used for years to supply heat and electricity to multiple buildings at specific sites.

End Of Slide

Energy Conservation

- **Energy conservation** is the process of saving energy by reducing energy use and waste.
- This can occur in many ways, including using energy-efficient devices and wasting less energy.
- Between 1975 and 1985, conservation made more energy available in the United States than all alternative energy sources combined did.

End Of Slide

Cities and Towns Saving Energy

- The town of Osage, Iowa, numbers 3,600 people.
- This town saved more than $1 million each year in energy because they found ways to conserve energy.
- In addition to saving energy, the town has greatly improved its economy through energy conservation.
- Businesses have relocated to the area to take advantage of low energy costs. Unemployment rates have also declined.

End Of Slide

Conservation Around the Home

- The average household in the U.S. spends more than $1,200 on energy bills each year.
- Unfortunately, much of the energy from homes is lost through poorly insulated windows, doors, walls, and the roof.
- There are dozens of ways to reduce energy use around the home.

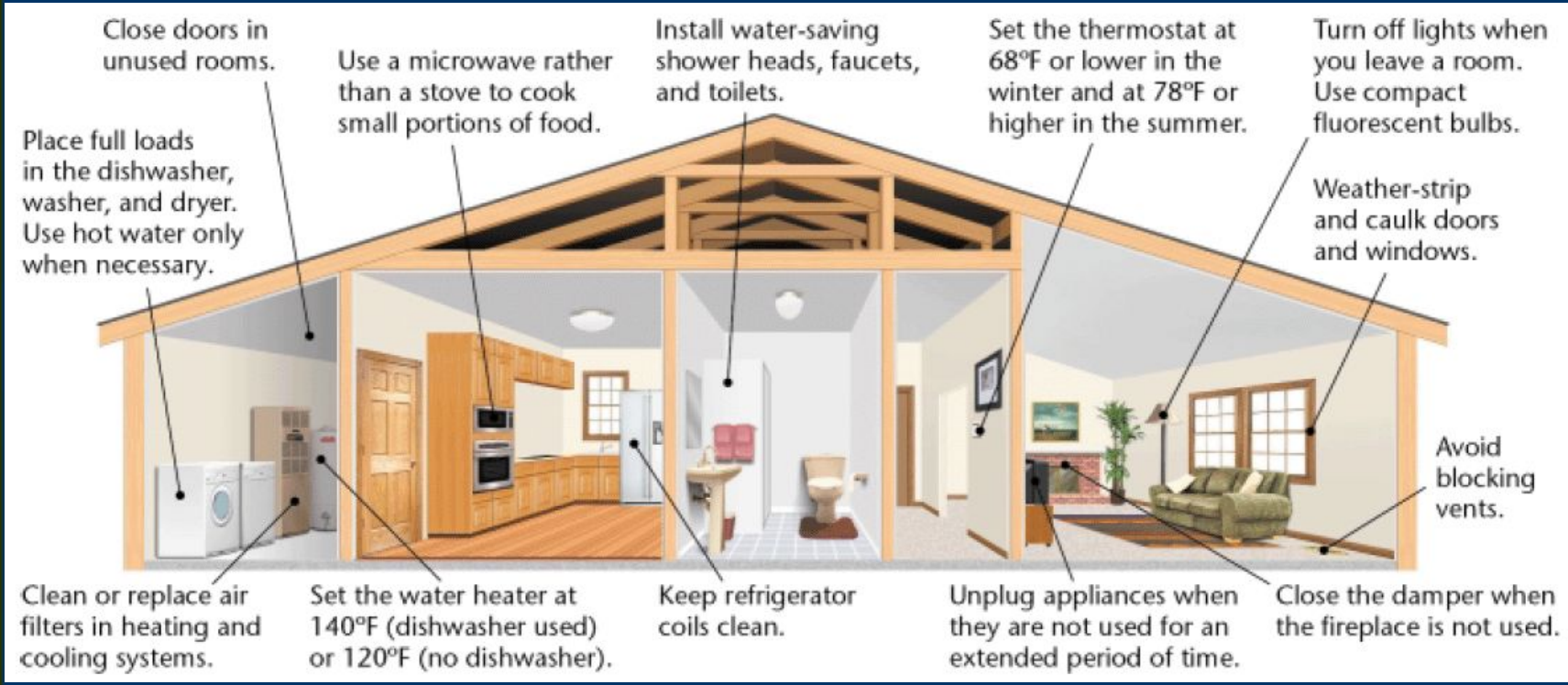
End Of Slide

Conservation in Daily Life

- There are many simple lifestyle changes that can help save energy.
- Using less of any resource usually translates into saving energy.

End Of Slide

Conservation Around the Home



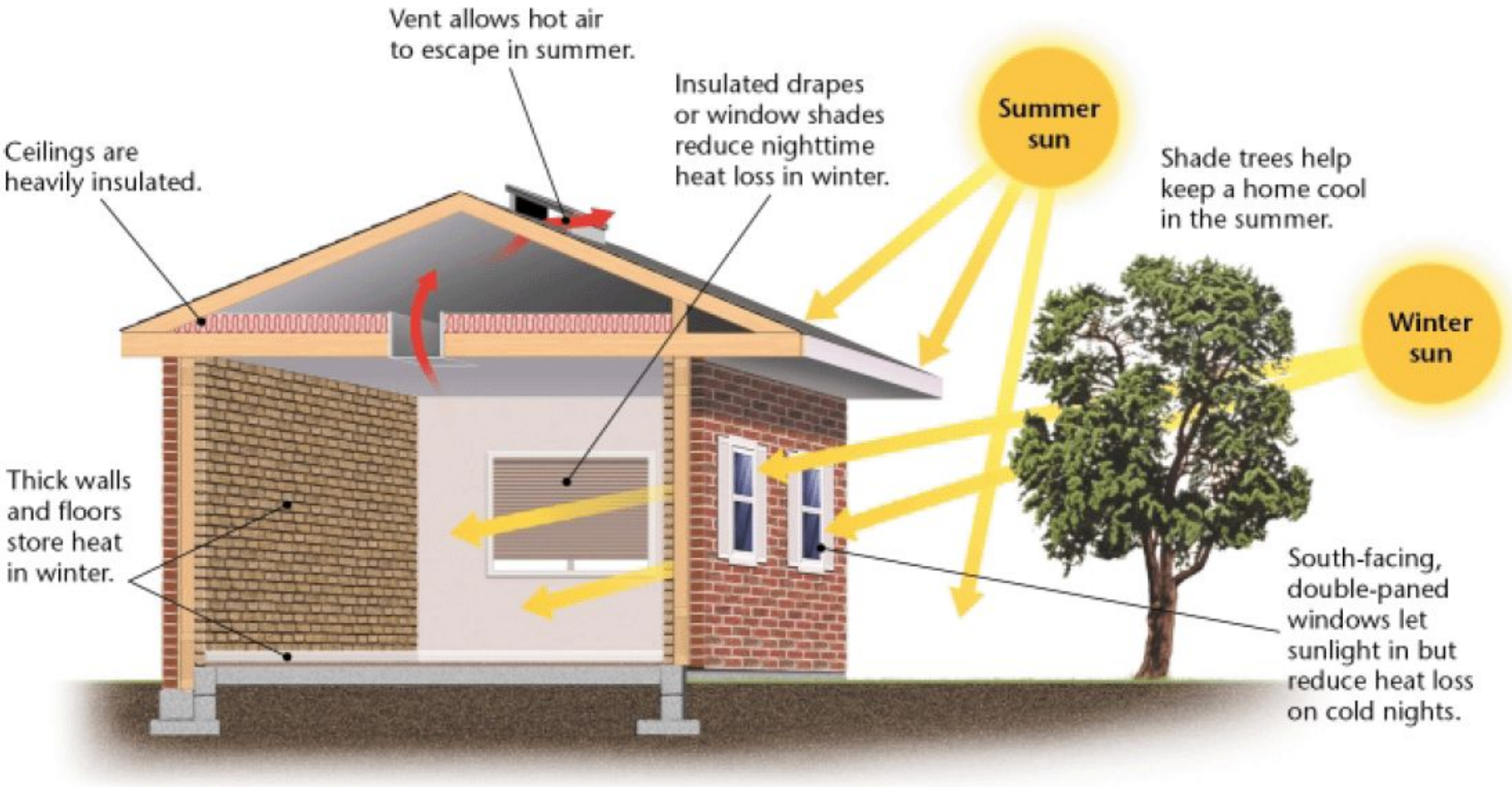
Bellringer

Section: Renewable Energy Today

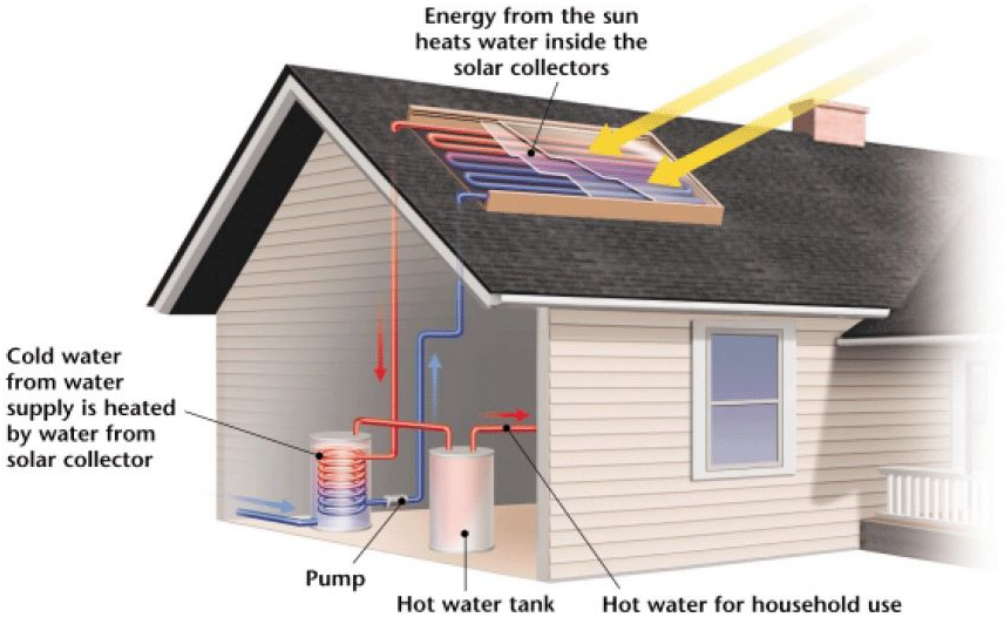
Think about how your great-grandparents met their energy needs. Which of these sources were renewable and which were non-renewable? Could any of these sources be used to meet modern needs?

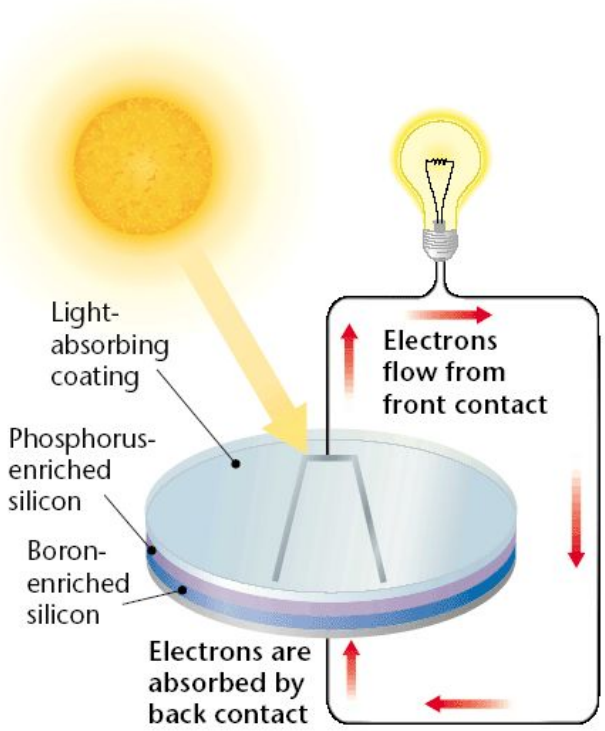
Write your responses in your ***EcoLog***.

A Passive-Solar Home

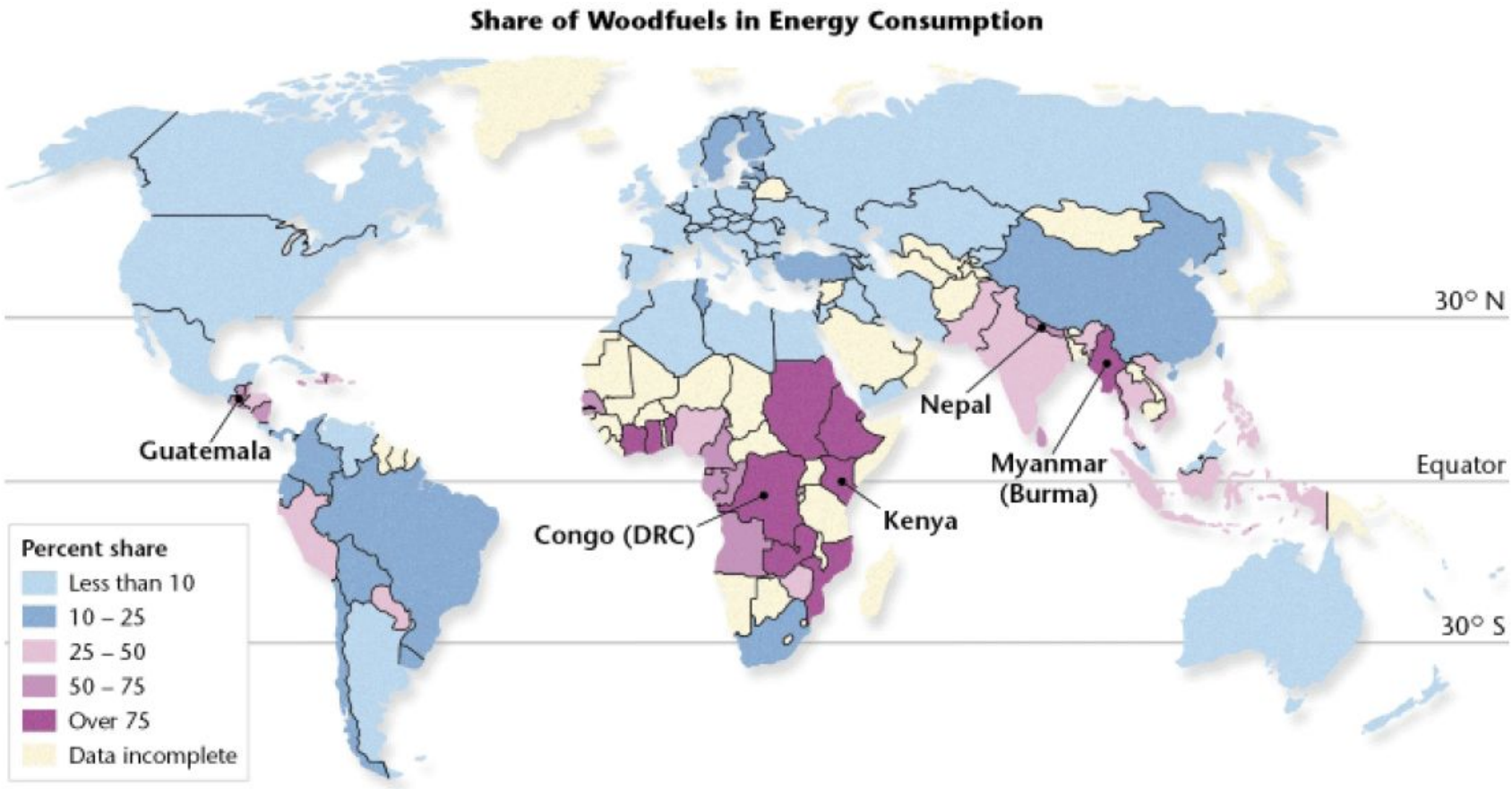


Active Solar Energy and PV Cells

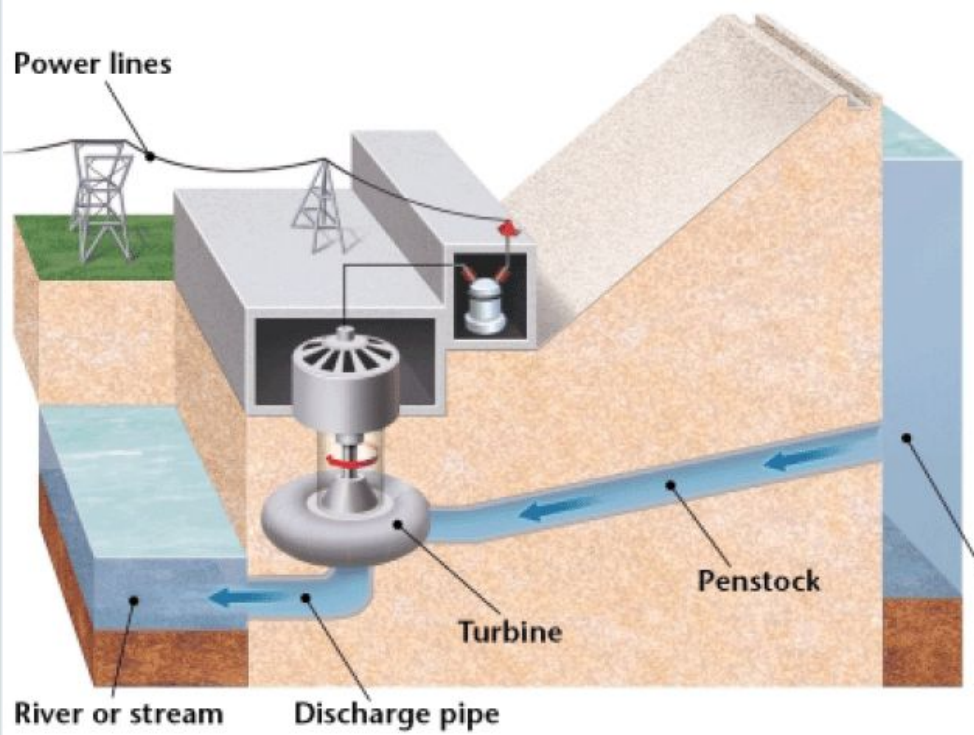


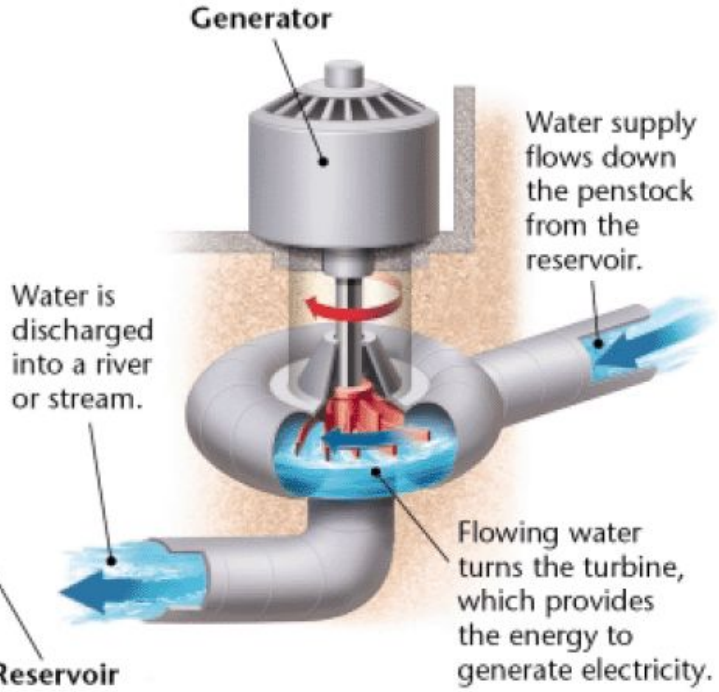


World Use of Woodfuels

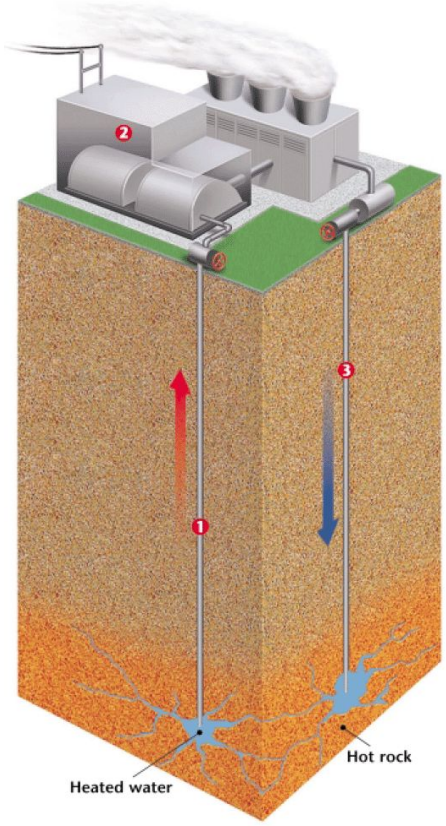


How Hydropower Works





Geothermal Energy and Geothermal Heat Pumps



The ground is warmer than the air in winter.

Heat is transferred from the ground to warm the house.

The ground is cooler than the air in summer.

Heat is transferred from the house to the ground to cool the house.

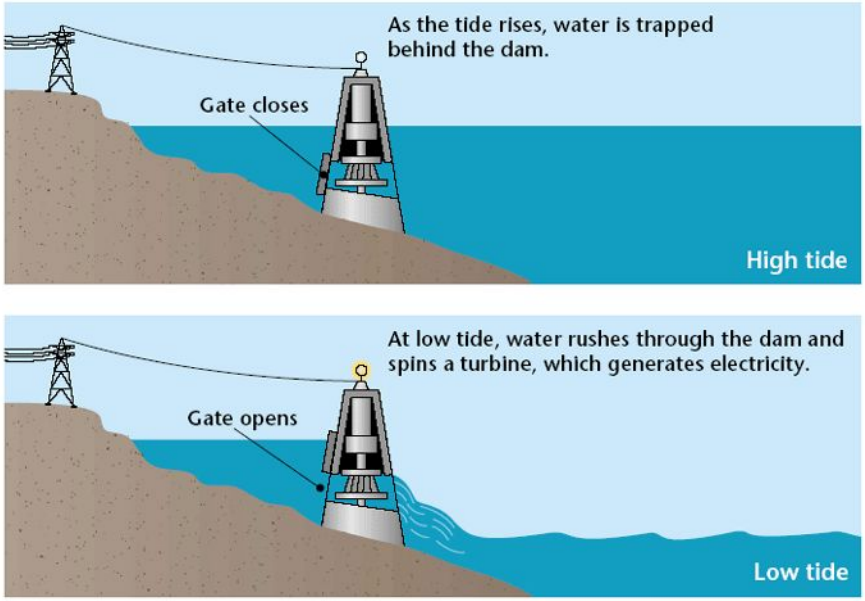
Bellringer

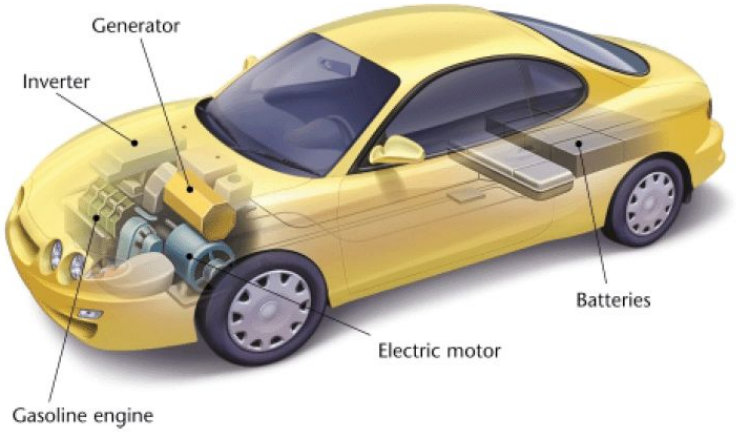
Section: Alternative Energy and Conservation

Look around the classroom to see if you can find any instances where energy is being wasted. Describe what you observe and what could be done differently to save energy.

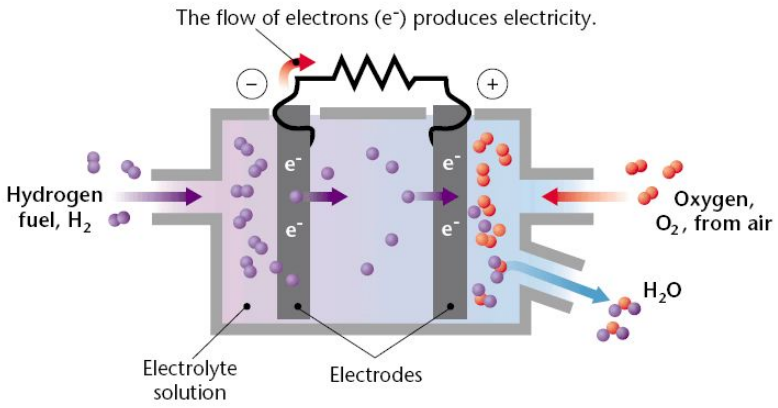
Write your responses in your ***EcoLog***.

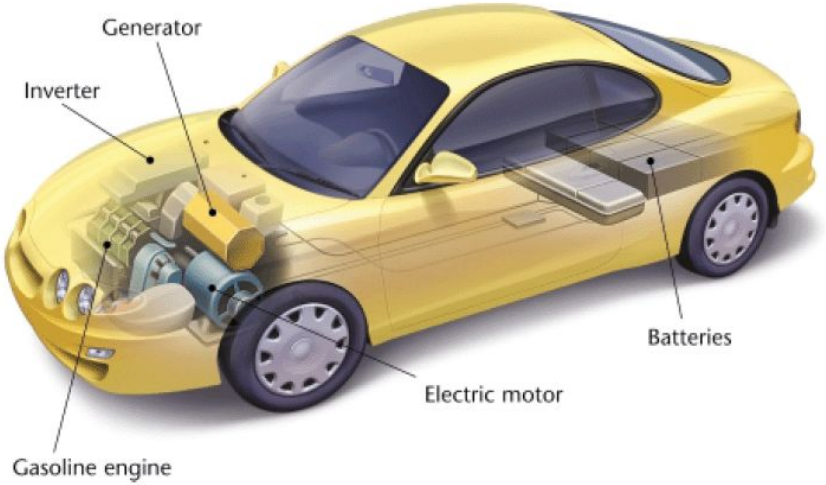
Tidal Power and OTEC





Fuels Cells and Hybrid Cars





Multiple Choice

1. What is the ultimate source of all renewable energy?

A. the biosphere
B. the moon
C. the ocean
D. the sun

Multiple Choice

1. What is the ultimate source of all renewable energy?

A. the biosphere
B. the moon
C. the ocean
D. the sun

Multiple Choice, *continued*

2. Which of the following is a renewable energy source?

F. coal mine
G. gas pipeline
H. power plant
I. wind farm

Multiple Choice, *continued*

2. Which of the following is a renewable energy source?

F. coal mine
G. gas pipeline
H. power plant
I. wind farm

Multiple Choice, *continued*

3. What is the most important factor in the development and implementation of alternative energy sources?

A. The most important factor is the abundance of the source.
B. The most important factor is its cost effectiveness.
C. The most important factor is whether government approval can be obtained.
D. The most important factor is if the source can gain social acceptance.

Multiple Choice, *continued*

3. What is the most important factor in the development and implementation of alternative energy sources?

A. The most important factor is the abundance of the source.
B. The most important factor is its cost effectiveness.
C. The most important factor is whether government approval can be obtained.
D. The most important factor is if the source can gain social acceptance.

Multiple Choice, *continued*

4. Why is hydrogen called the fuel of the future?

F. It is very inexpensive to produce.
G. It requires very little energy to produce.
H. It is the most abundant element in the universe.
I. It contains carbon which disperses in the atmosphere when burned.

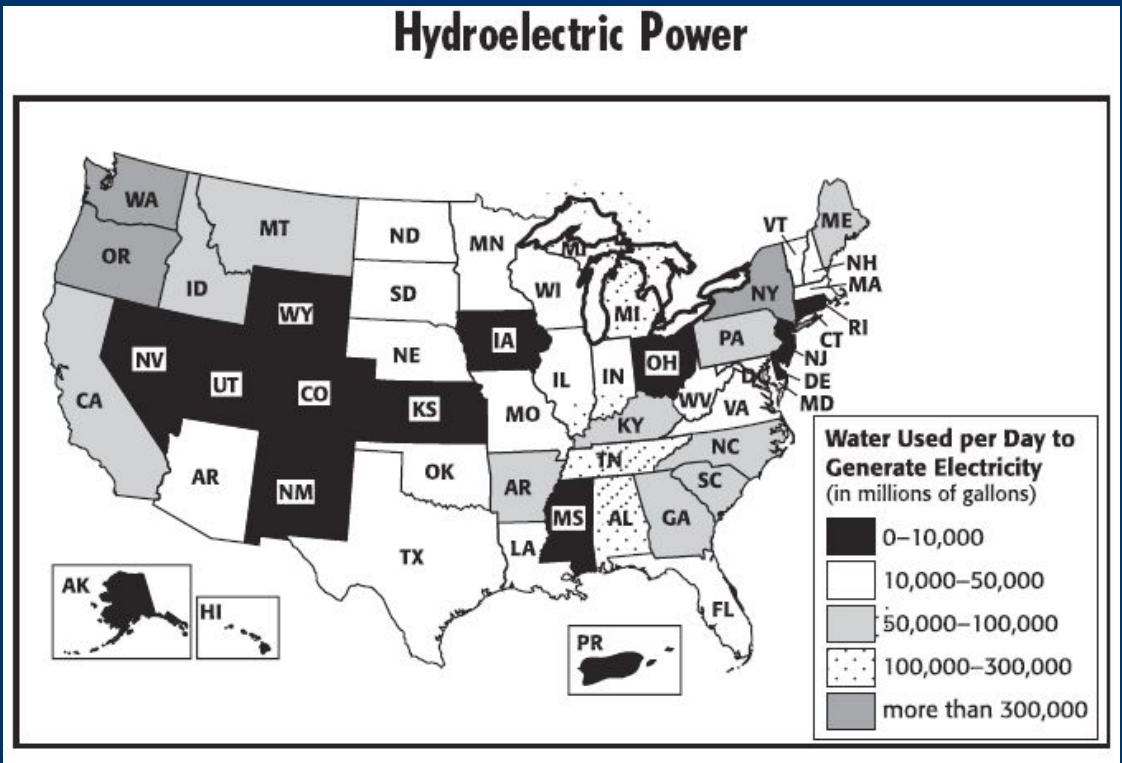
Multiple Choice, *continued*

4. Why is hydrogen called the fuel of the future?

F. It is very inexpensive to produce
G. It requires very little energy to produce.
H. It is the most abundant element in the universe.
I. It contains carbon which disperses in the atmosphere when burned.

Multiple Choice, *continued*

Use this map to answer questions 5 and 6.



Multiple Choice, *continued*

5. What can be inferred about the use of hydroelectric power in the United States?

A. There are more dams in Oregon than in Kansas.
B. There is more hydroelectric power used in New Mexico than in Alabama.
C. The upper Midwest uses more water for hydroelectric power than New England.
D. The biggest users of water for hydroelectricity are located along the Mississippi River.

Multiple Choice, *continued*

5. What can be inferred about the use of hydroelectric power in the United States?

A. There are more dams in Oregon than in Kansas.
B. There is more hydroelectric power used in New Mexico than in Alabama.
C. The upper Midwest uses more water for hydroelectric power than New England.
D. The biggest users of water for hydroelectricity are located along the Mississippi River.

Multiple Choice, *continued*

6. How many states use 10,000 million gallons of water or less per day?

F. 5
G. 10
H. 15
I. 20

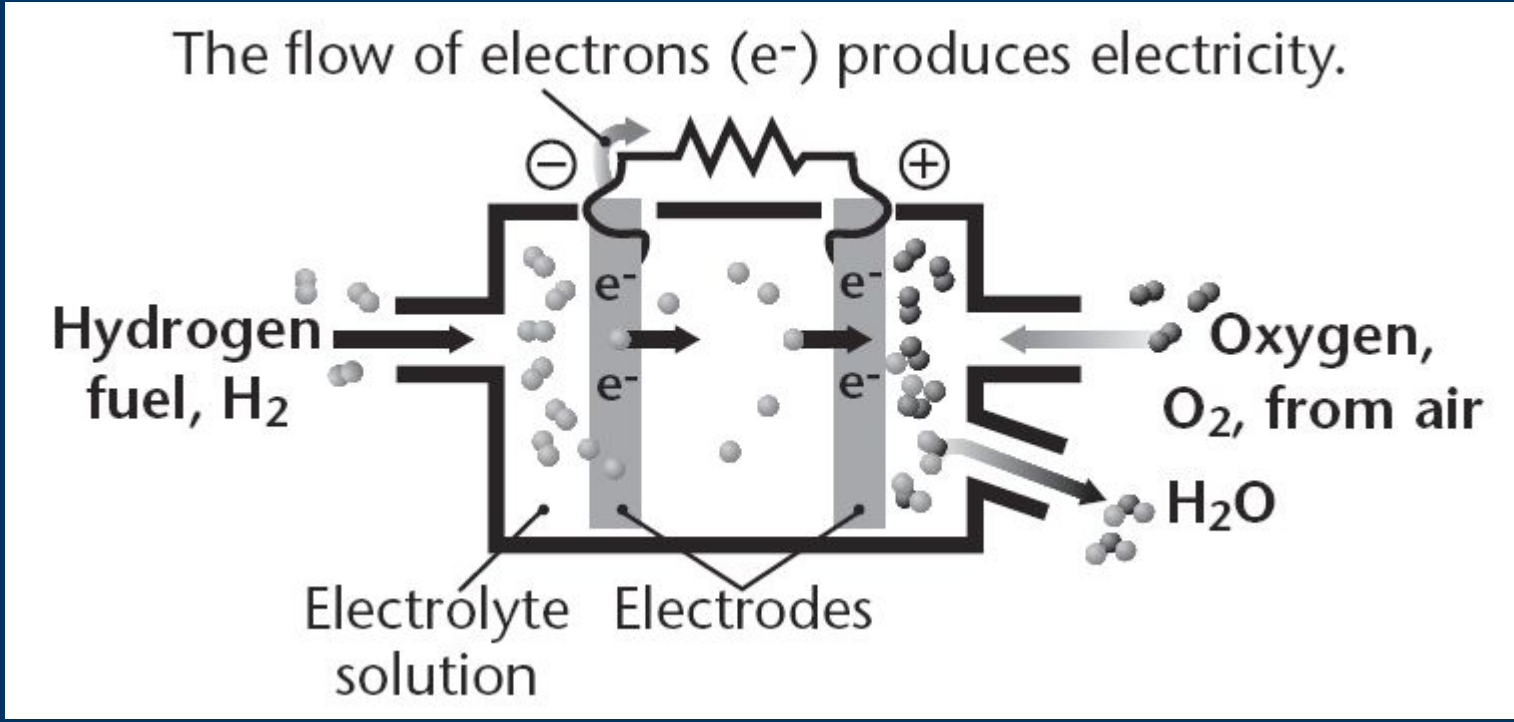
Multiple Choice, *continued*

6. How many states use 10,000 million gallons of water or less per day?

F. 5
G. 10
H. 15
I. 20

Multiple Choice, *continued*

Use this map to answer question 7.



Multiple Choice, *continued*

7. What type of electrical generation is depicted in the diagram?

A. fuel cell
B. geothermal plant
C. ocean thermal energy
D. tidal plant

Multiple Choice, *continued*

7. What type of electrical generation is depicted in the diagram?

A. fuel cell
B. geothermal plant
C. ocean thermal energy
D. tidal plant

Image and Activity Bank

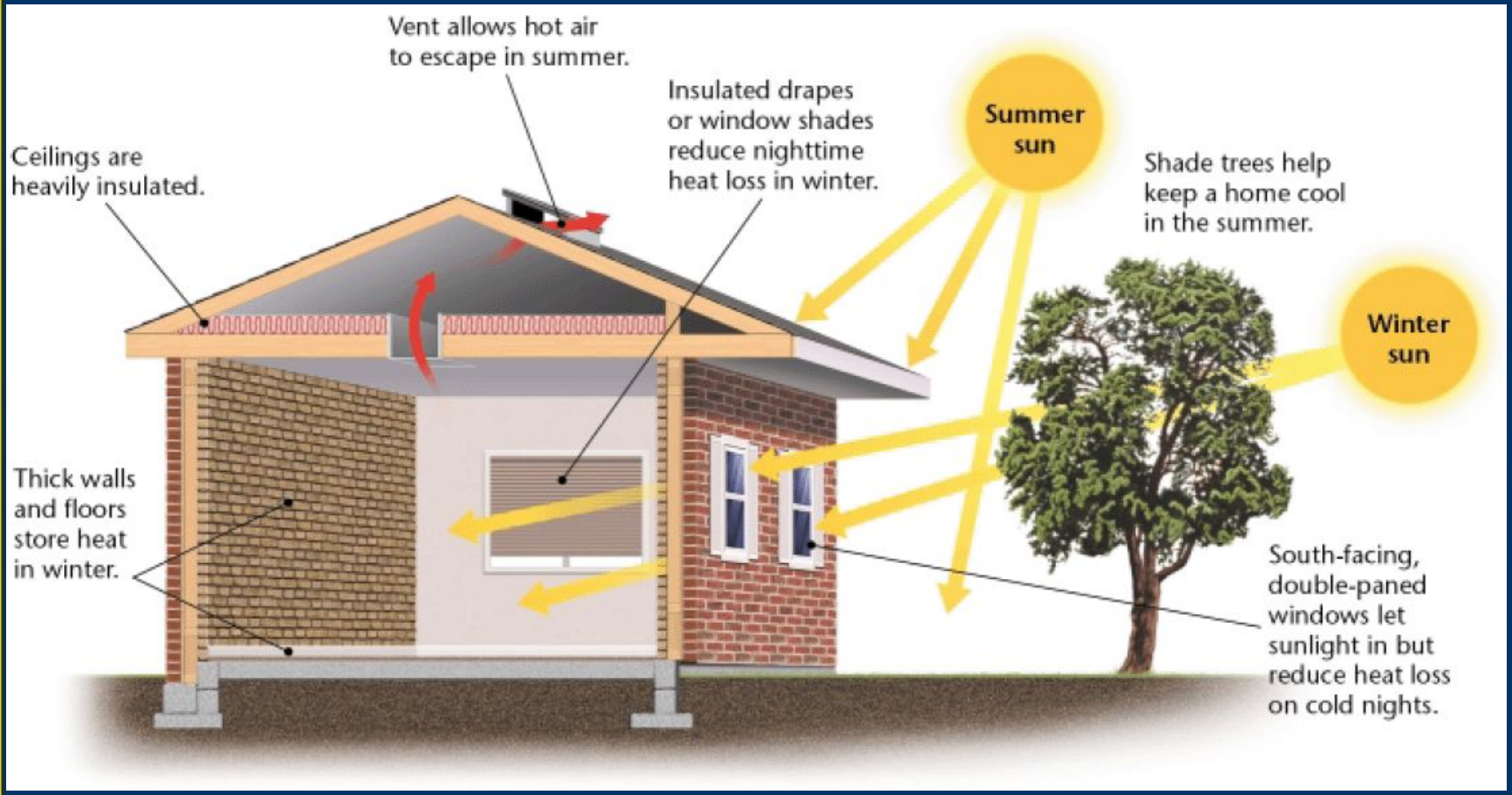


Image and Activity Bank

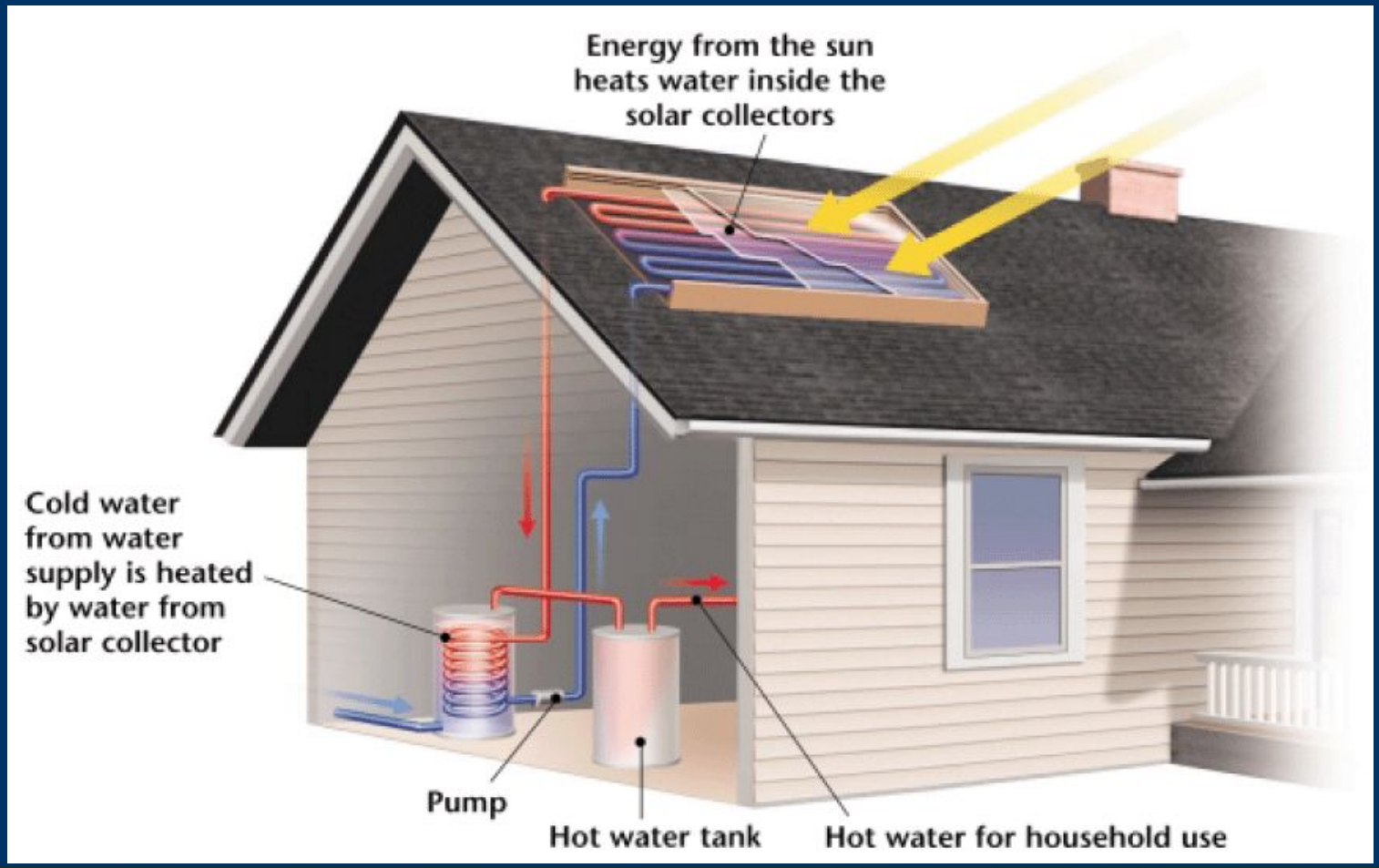


Image and Activity Bank

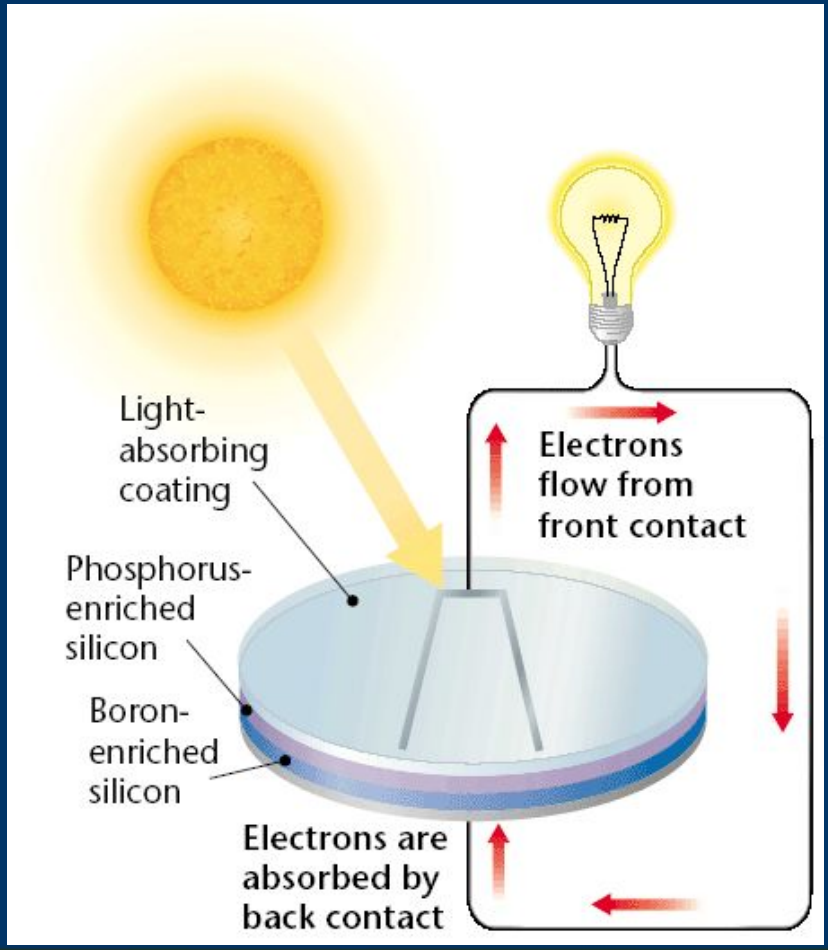


Image and Activity Bank

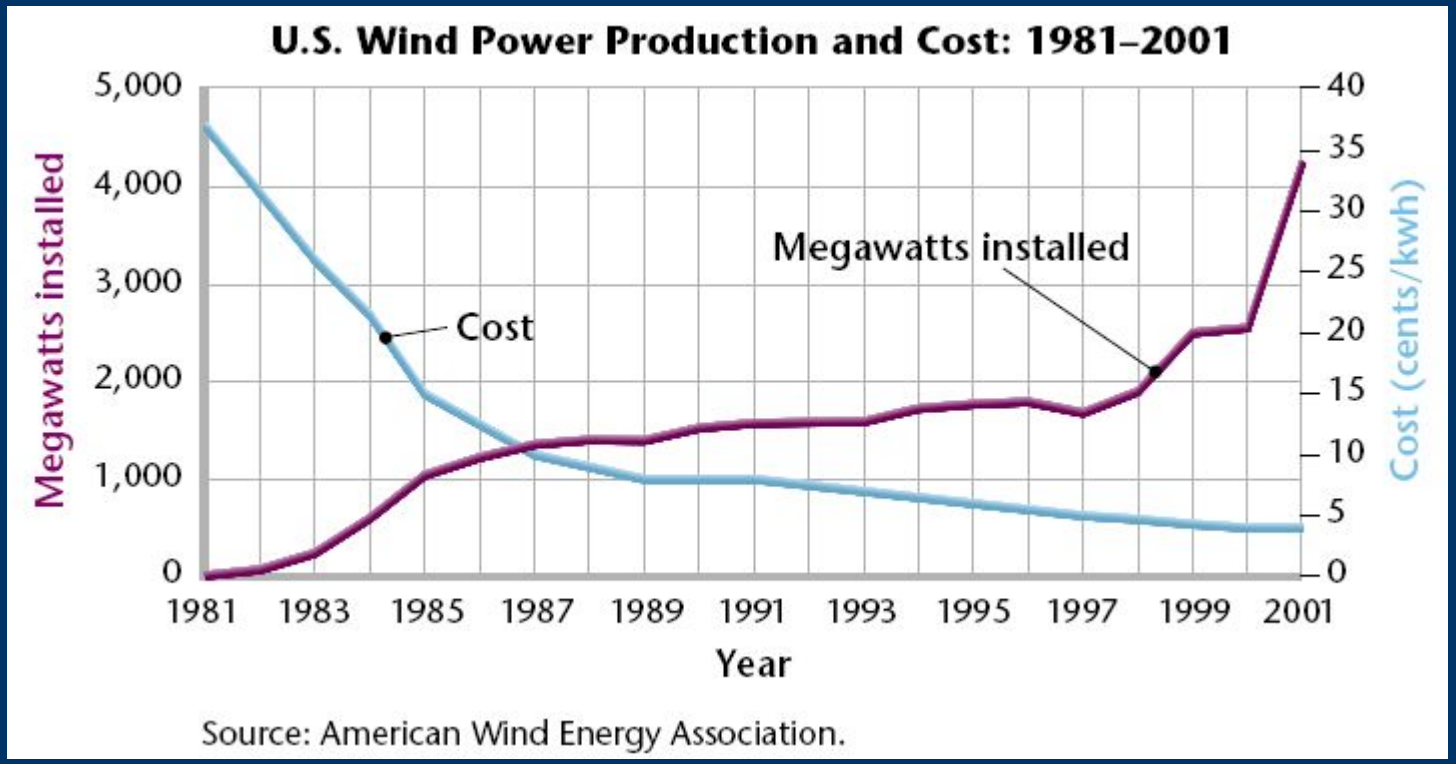


Image and Activity Bank

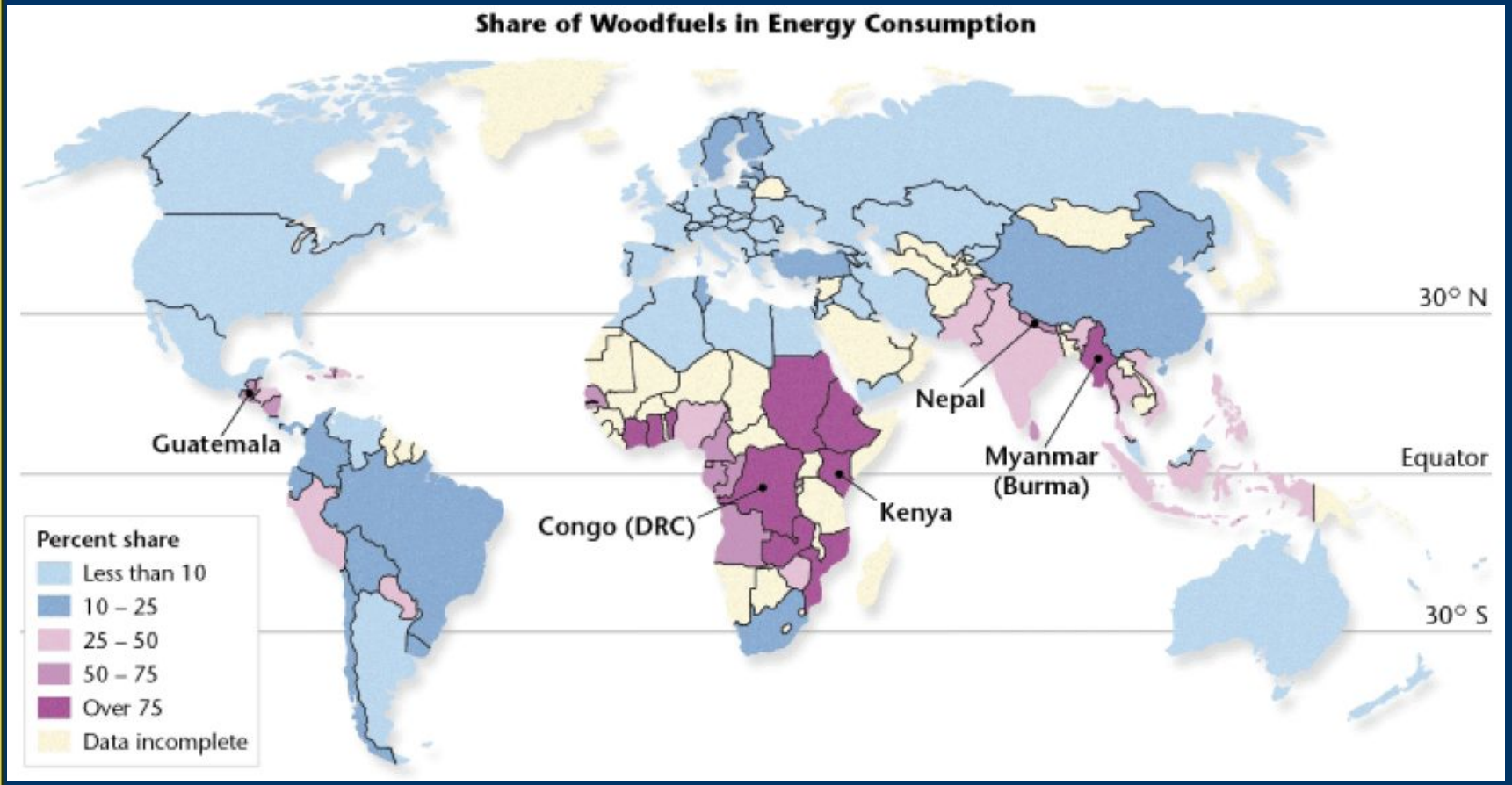


Image and Activity Bank

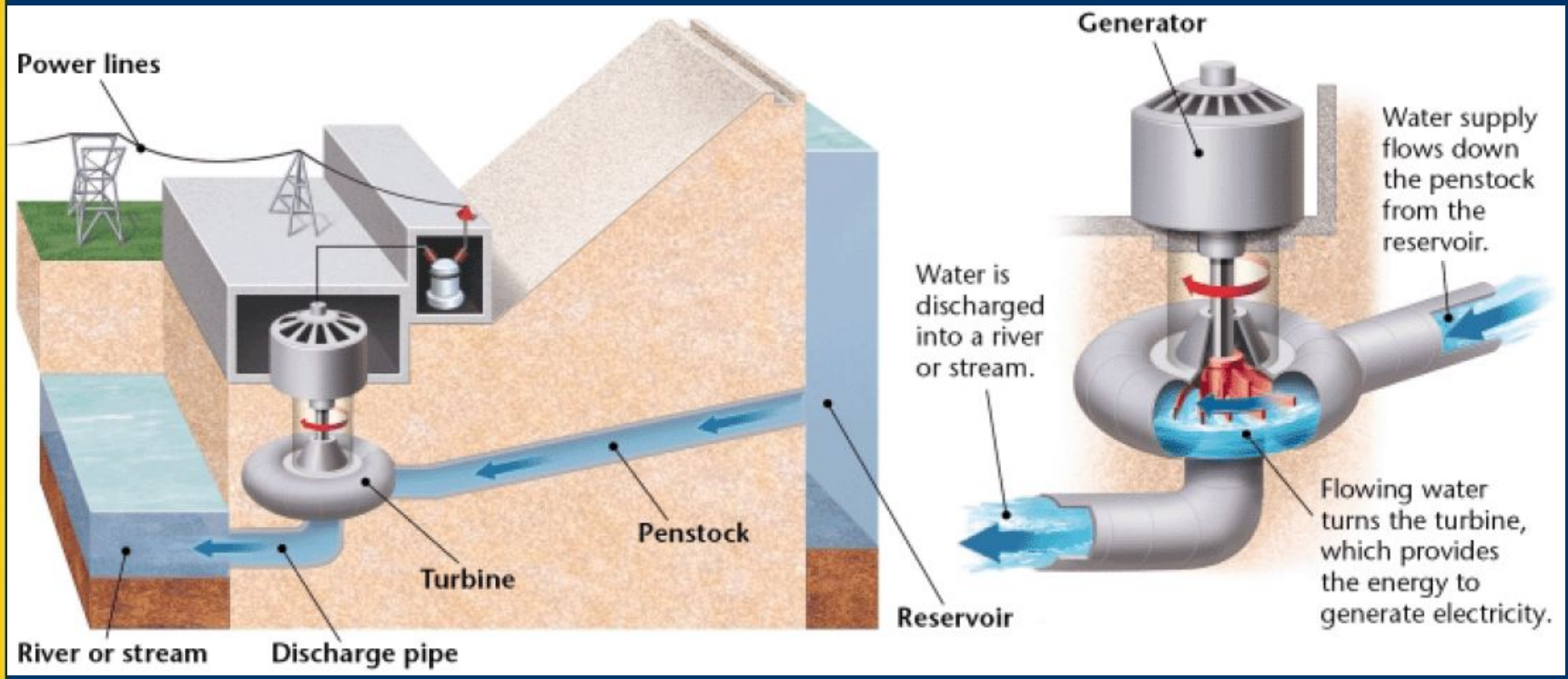


Image and Activity Bank

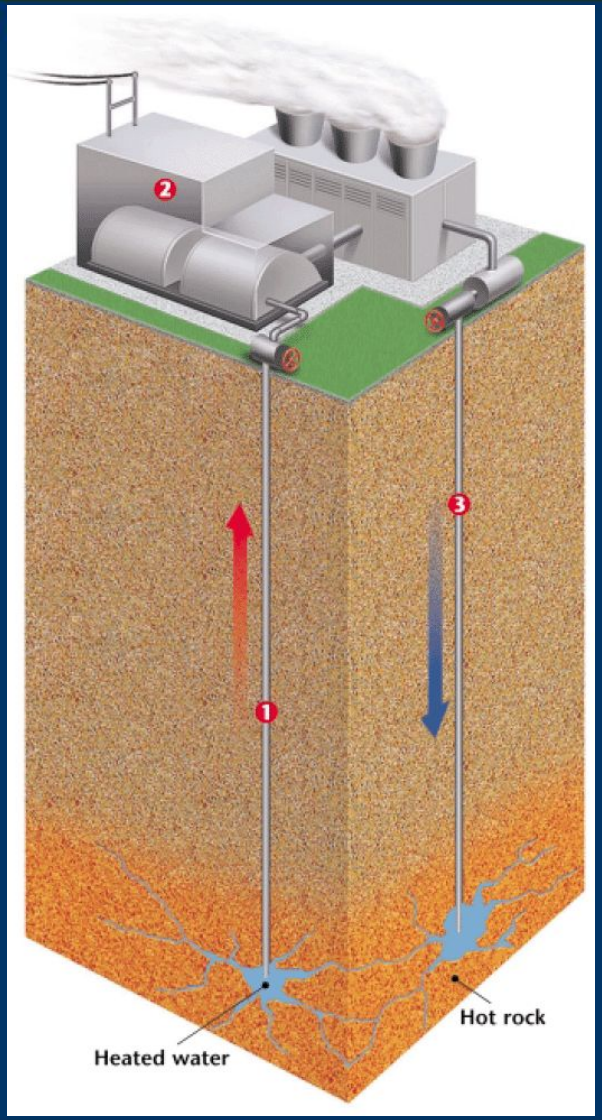


Image and Activity Bank

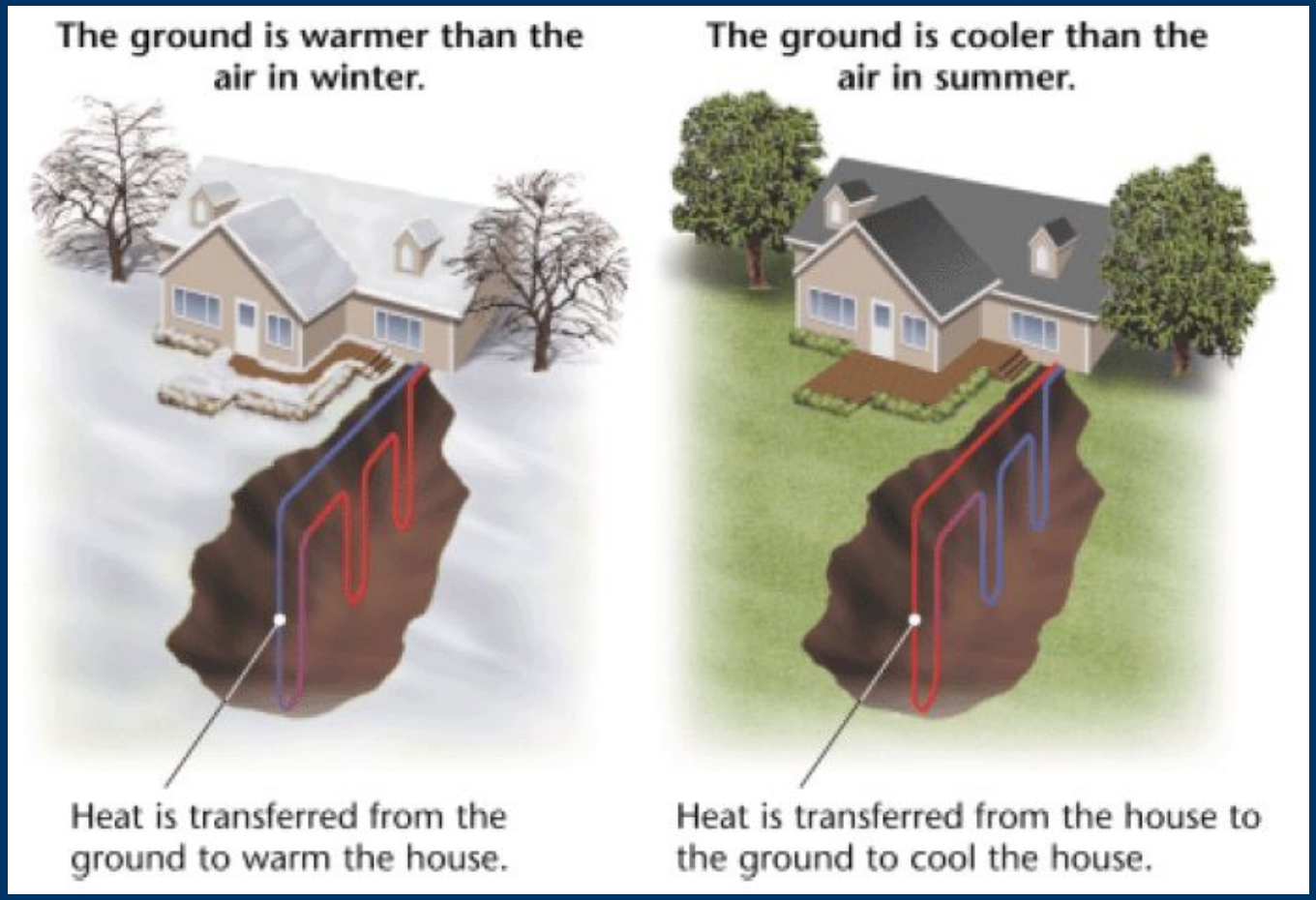


Image and Activity Bank

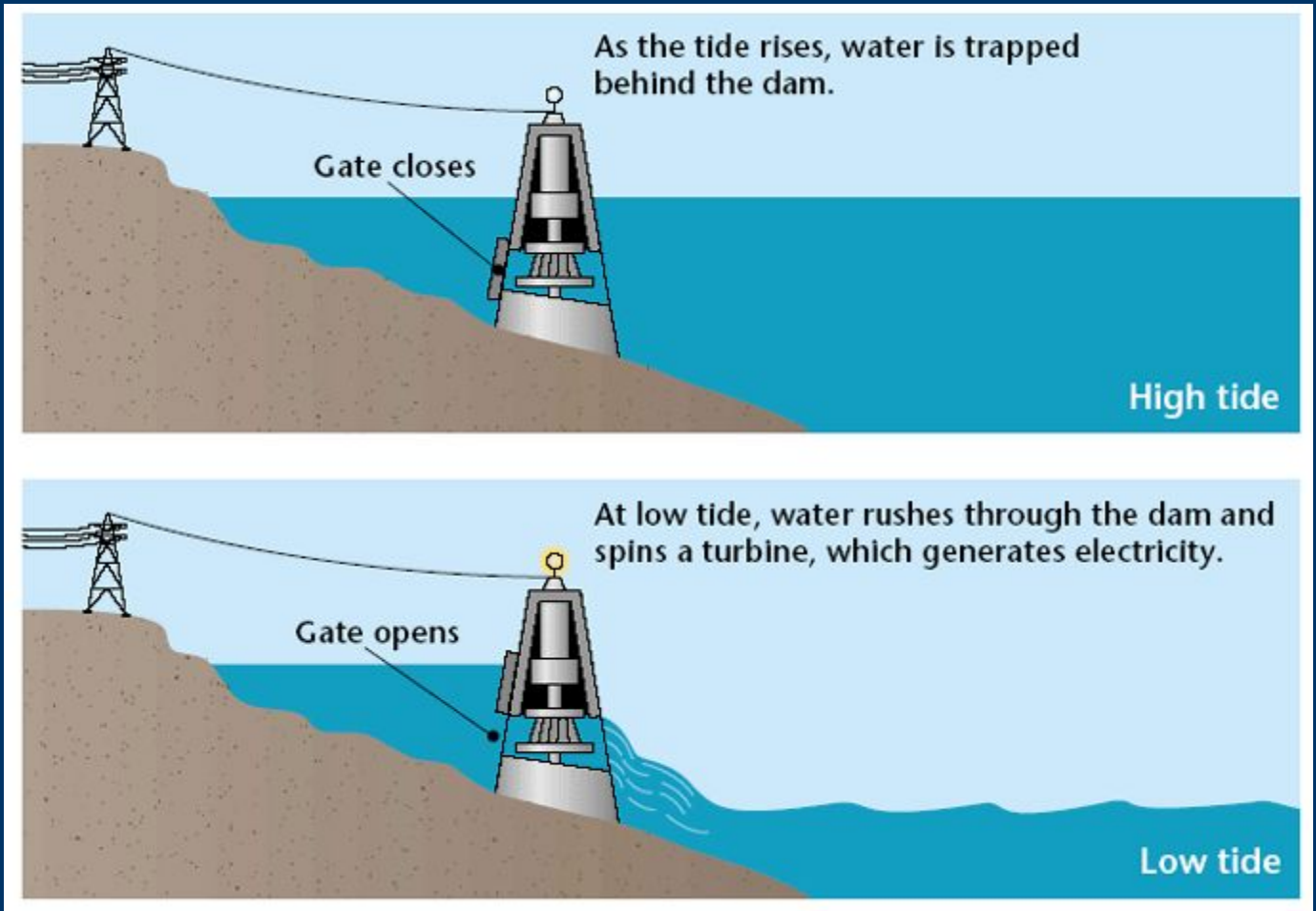


Image and Activity Bank

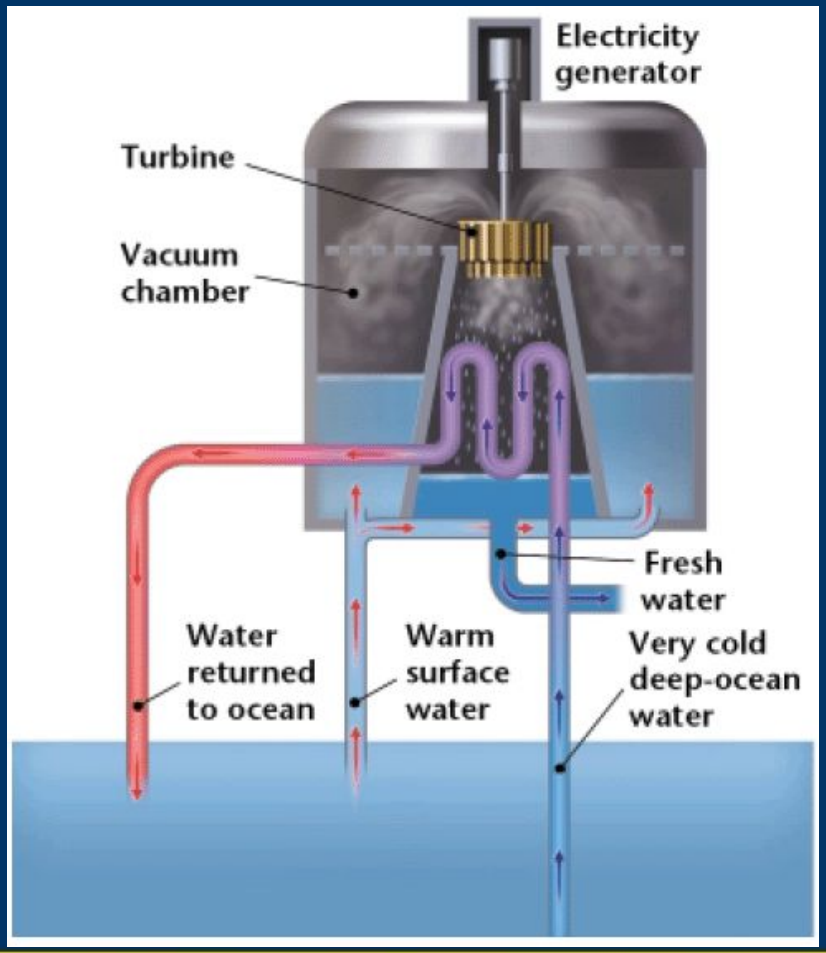


Image and Activity Bank

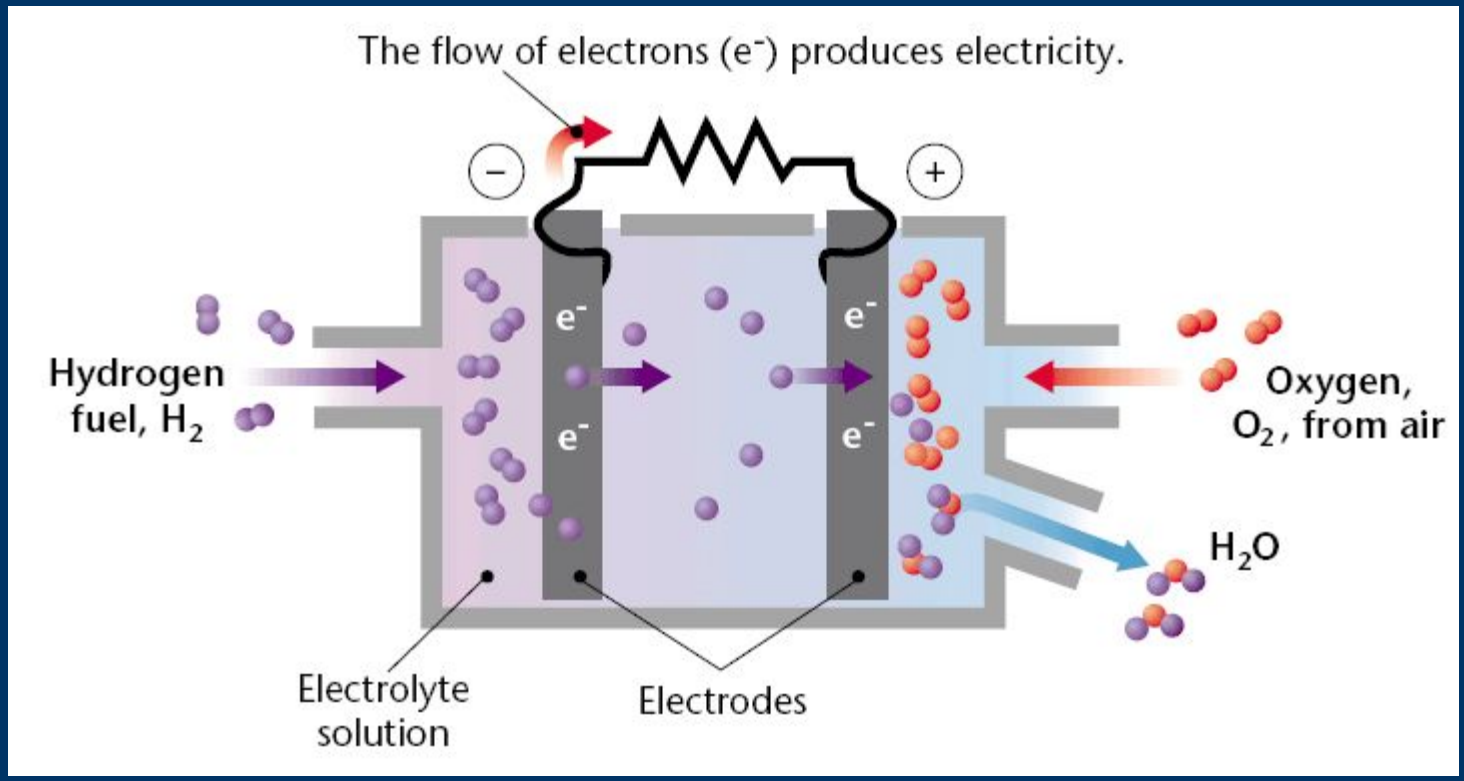
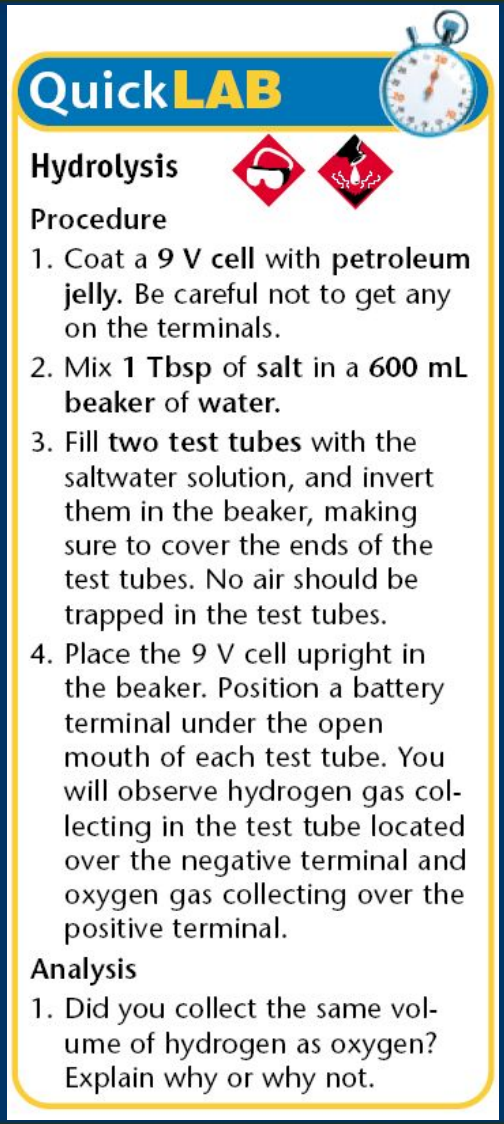


Image and Activity Bank



QuickLAB

Hydrolysis

Procedure

1. Coat a **9 V cell** with **petroleum jelly.** Be careful not to get any on the terminals.
2. Mix **1 Tbsp** of **salt** in a **600 mL beaker** of **water.**
3. Fill **two test tubes** with the saltwater solution, and invert them in the beaker, making sure to cover the ends of the test tubes. No air should be trapped in the test tubes.
4. Place the 9 V cell upright in the beaker. Position a battery terminal under the open mouth of each test tube. You will observe hydrogen gas collecting in the test tube located over the negative terminal and oxygen gas collecting over the positive terminal.

Analysis

1. Did you collect the same volume of hydrogen as oxygen? Explain why or why not.

Image and Activity Bank

Energy Efficiency of Common Conversion Devices	
Device	**Efficiency**
Incandescent light bulb	5%
Fluorescent light bulb	22%
Internal combustion engine (gasoline)	10%
Human body	20%–25%
Steam turbine	45%
Fuel cell	60%

Image and Activity Bank

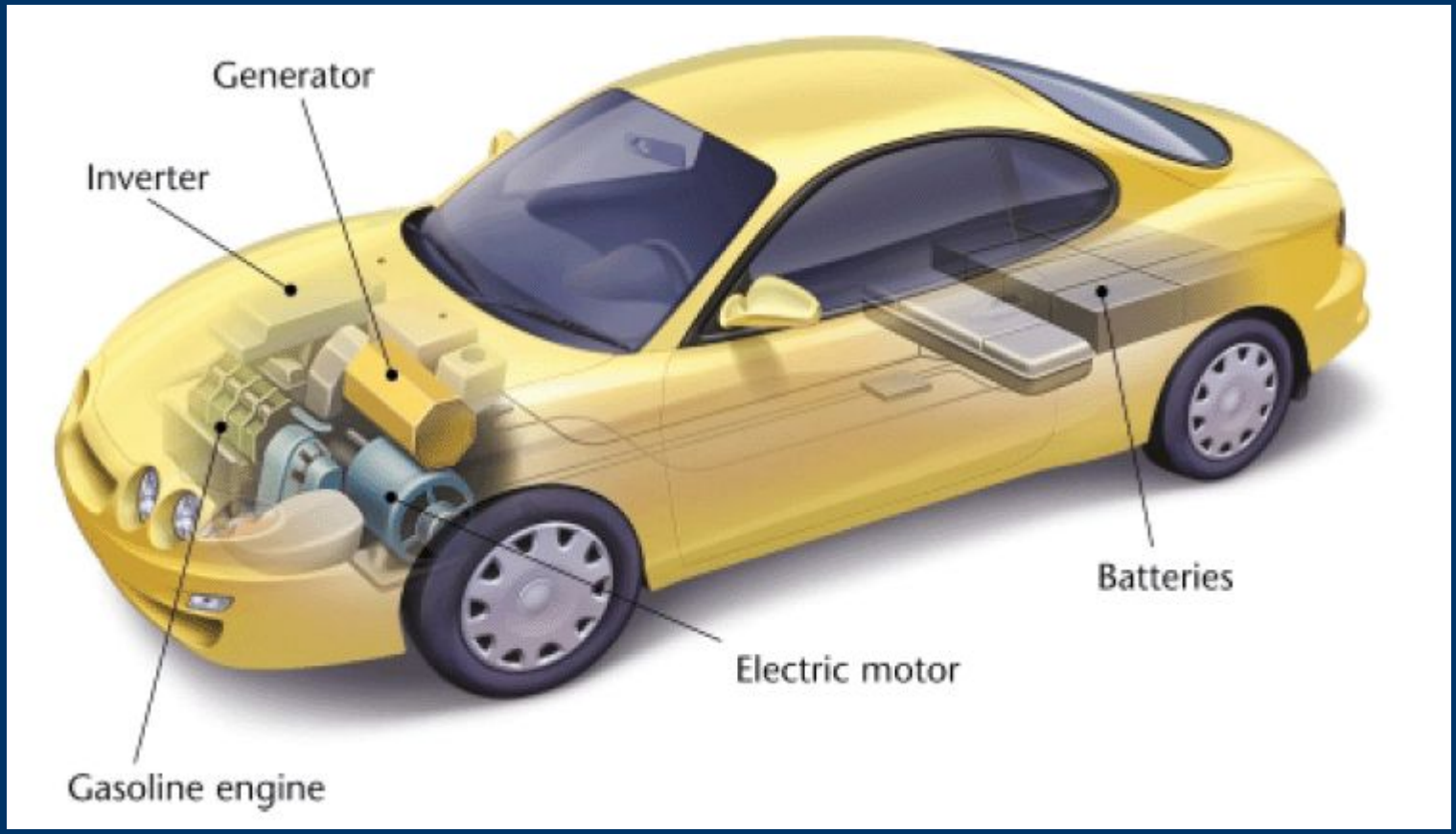


Image and Activity Bank

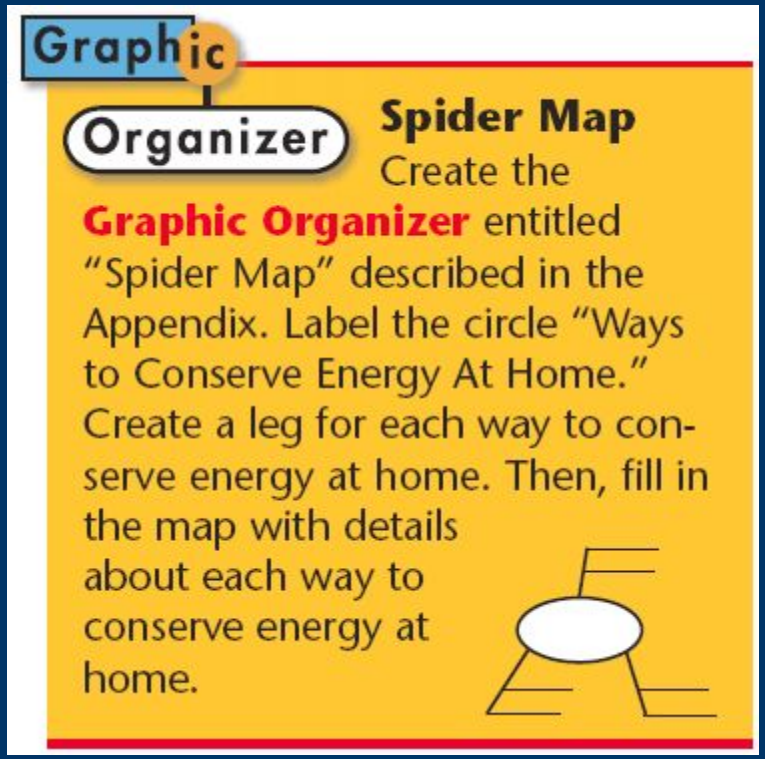


Image and Activity Bank

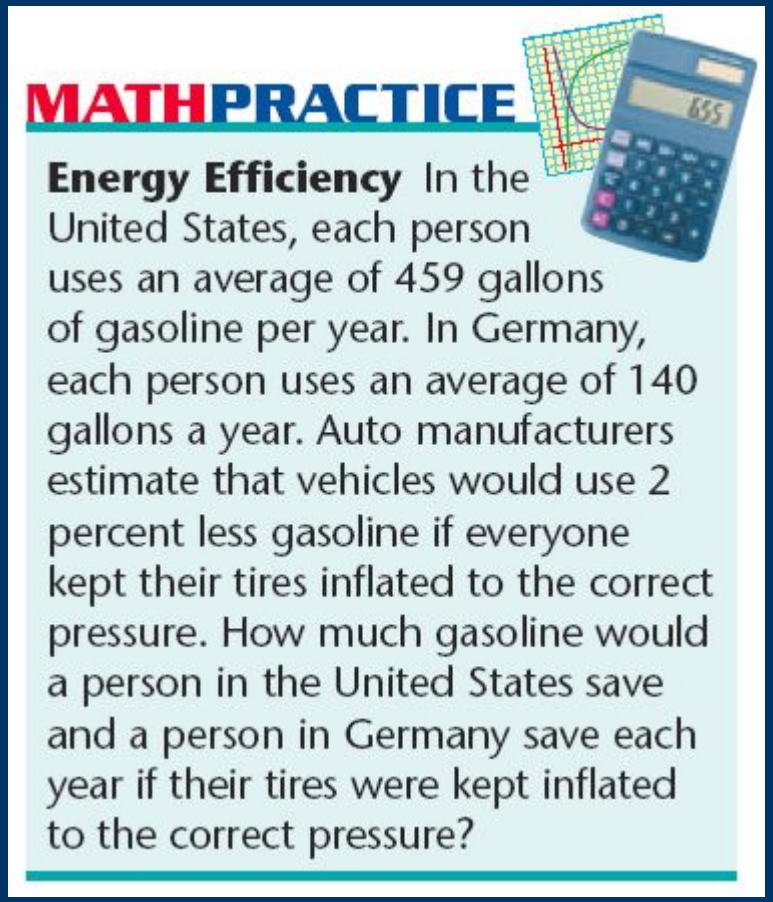


Image and Activity Bank

Energy Conservation Tips

- Walk or ride a bicycle for short trips.
- Carpool or use public transportation whenever possible.
- Drive a fuel-efficient automobile.
- Choose ENERGY STAR® products.
- Recycle and choose recycled products whenever possible.
- Set computers to "sleep" mode when they are not in use.

Image and Activity Bank