Earth's Atmosphere

Air Currents

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.

Before	Statement	After
	5. Uneven heating in different parts of the atmosphere creates air circulation patterns.	
	6. Warm air sinks and cold air rises.	

Read to Learn

Global Winds

Wind patterns can be global or local. There are great wind belts that circle Earth. The energy that causes this large movement of air comes from the Sun.

Unequal Heating of Earth's Surface

The Sun's energy warms Earth. Not all areas on Earth's surface receive the same amount of energy from the Sun. The amount of energy an area gets depends on the Sun's angle. Energy coming from the rising or setting Sun is not very strong. But Earth warms quickly when the Sun is high in the sky around noon.

Sunlight Areas in low latitudes near the equator are referred to as the tropics. Sunlight strikes Earth's surface there at a high angle. It is nearly a 90° angle all year-round. As a result, the tropics receive more sunlight per unit of surface area than other places on Earth. This causes the land, the water, and the air at the equator to always be warm.

At latitudes near the North Pole and the South Pole, sunlight strikes Earth's surface at a low angle. Sunlight is spread over a larger surface area than in the tropics. This means that the poles receive very little energy per unit of surface area and so they are cooler.

Key Concepts

- How does uneven heating of Earth's surface result in air movement?
- How are air currents on Earth affected by Earth's spin?
- What are the main wind belts on Earth?

Study Coach

Finding Main Ideas
Highlight the main idea of each paragraph in this lesson. Reread the sentences to review the lesson.

Reading Check

1. Identify What is the source of energy of global wind belts?

Wind Recall that warm air rises and cold air sinks. Warm air is less dense than cold air. Rising warm air puts less pressure on Earth than cooler air. Air pressure is usually low over the tropics because it is usually warm there. Air pressure is usually high over colder areas such as the North and South Poles. This difference in pressure creates wind. **Wind** *is the movement of air from areas of high pressure to areas of low pressure.* Global wind belts influence both climate and weather on Earth.

Key Concept Check

2. Explain How does uneven heating of Earth's surface result in air movement?

Global Wind Belts

The figure below shows the three-cell model used to describe circulation in Earth's atmosphere. Three cells exist in both the northern hemisphere and the southern hemisphere.

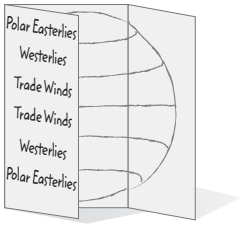
In the first cell, hot air near the equator moves to the top of the troposphere. Then, the air moves toward the poles until it cools and moves back to Earth's surface near 30° latitude. Most of the air in this convection cell then returns to the equator near Earth's surface.

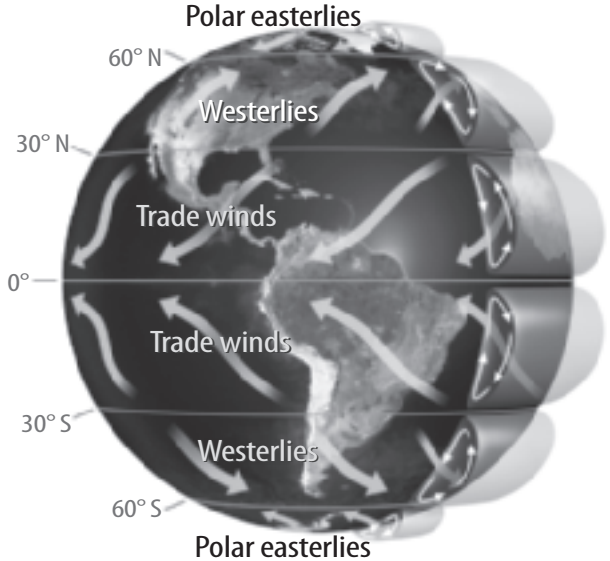
The third cell is at the highest latitudes and is also a convection cell. Air from the poles moves toward the equator along Earth's surface. Warmer air is pushed upward by cooler air near 60° latitude.

The second cell is between 30° and 60° latitude and is not a convection cell. Its motion is driven by the other two cells. Imagine rolling cookie dough between your hands. Your hand represent the first and third cells. The cookie dough is the second cell. This second cell moves in much the same way as the dough.

FOLDABLES®

Make a shutterfold book to describe Earth's global wind belts and to explain how they circulate.





Visual Check

3. Identify Which wind belt do you live in?

The Coriolis Effect

What would happen if you threw a ball to someone sitting across from you on a moving merry-go-round? When the ball reached the opposite side, the person would have moved. The ball would have appeared to have curved. Like a merry-go-round, the rotation of Earth causes moving air and water to appear to move to the right in the northern hemisphere and to the left in the southern hemisphere. This is called the Coriolis effect. The difference between high and low pressure and the Coriolis effect create distinct wind patterns. These wind patterns are called prevailing winds.

Key Concept Check

4. Describe How are air currents on Earth affected by Earth's spin?

Prevailing Winds

The three global wind cells in each hemisphere create northerly and southerly winds. When the Coriolis effect acts on the winds, the winds blow to the east or the west. These winds are relatively steady and predictable.

The **trade winds** *are steady winds that flow from east to west between 30°N latitude and 30°S latitude.* At about 30°N and 30°S latitude, air cools and sinks. This creates areas of high pressure and light, calm winds called the doldrums. Sailboats without engines can be stranded in the doldrums.

Reading Check

5. Explain What might happen to a sailboat caught in the doldrums?

The prevailing **westerlies** *are steady winds that flow from west to east between latitudes 30°N and 60°N, and 30°S and 60°S. The* **polar easterlies** *are cold winds that blow from east to west near the North Pole and the South Pole.*

Key Concept Check

6. Summarize What are the main wind belts on Earth?

Jet Streams

Near the top of the troposphere is a narrow band of high winds called the **jet stream.** Jet streams flow around Earth from west to east, often making large loops to the north or the south. Jet streams also influence weather. They move cold air from the poles toward the tropics. Jet streams also move warm air from the tropics toward the poles. Jet streams can move as fast as 300 km/h.

Local Winds

Recall that global winds occur because of pressure differences around the globe. In the same way, local winds occur whenever air pressure is different from one location to another.

Sea and Land Breezes

If you have ever been to a lake or an ocean, you have probably experienced the connections among temperature, air pressure, and wind. *A* **sea breeze** *is wind that blows from the sea to the land due to local temperature and pressure differences.*

The left side of the figure below shows how a sea breeze forms. Land warms faster than water does. On sunny days, the air over the land warms by conduction and rises, creating an area of low pressure. The air over the water sinks. This creates an area of high pressure because it is cooler. The differences in pressure over the warm land and the cooler water results in a cool wind that blows from the sea onto the land.

A **land breeze** *is a wind that blows from the land to the sea due to local temperature and pressure differences.* The right side of the figure below shows how a land breeze forms. At night, the land cools more quickly than the water. The air above the land also cools more quickly than the air above the water. As a result, an area of lower pressure forms over the warmer water. In a land breeze, cool air over land moves toward lower pressure over the water.

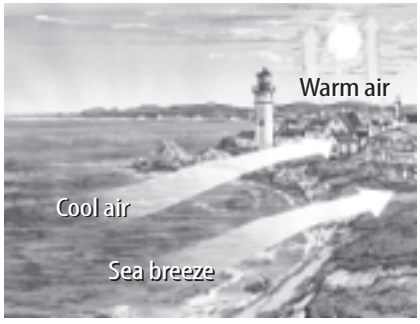
Reading Check

7. Compare and Contrast Explain how sea and land breezes are the same and different.

Visual Check

8. Sequence the steps involved in the formation of a land breeze.

Sea Breeze



Land Breeze