

# Air Movement

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# CHAPTER 1

# Air Movement

## Lesson Objectives

- Explain why air moves.
- Identify causes of local winds.
- Describe global winds and jet streams.

## Vocabulary

- global wind
- jet stream
- land breeze
- local wind
- monsoon
- sea breeze
- wind

## Introduction

Whether it's a gentle breeze or strong wind, you are most aware of air when it moves. You can feel its molecules press against you. You can also see the effects of air movement. **Figure 1.1** shows some examples.



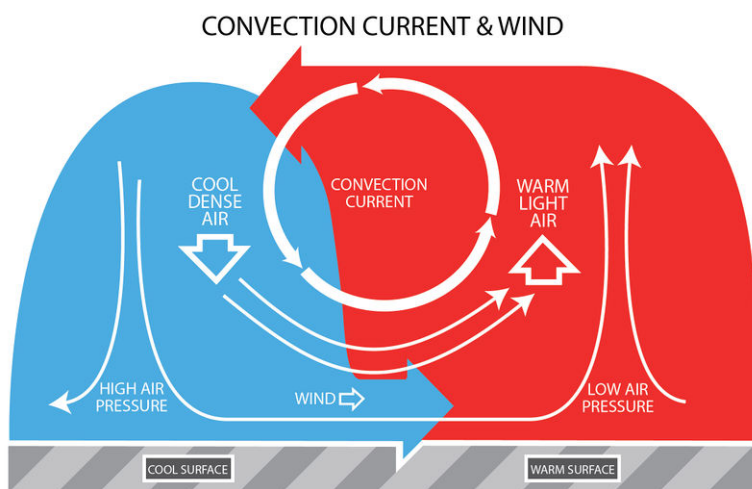
**FIGURE 1.1**

How can you tell the wind is blowing in these photos?

## Why Air Moves

Air movement takes place in the troposphere. This is the lowest layer of the atmosphere. Air moves because of differences in heating. These differences create convection currents and winds. **Figure 1.2** shows how this happens.

- Air in the troposphere is warmer near the ground. The warm air rises because it is light. The light, rising air creates an area of low air pressure at the surface.
- The rising air cools as it reaches the top of the troposphere. The air gets denser, so it sinks to the surface. The sinking, heavy air creates an area of high air pressure near the ground.
- Air always flows from an area of higher pressure to an area of lower pressure. Air flowing over Earth's surface is called **wind**. The greater the difference in pressure, the stronger the wind blows.



**FIGURE 1.2**

Differences in air temperature cause convection currents and wind.

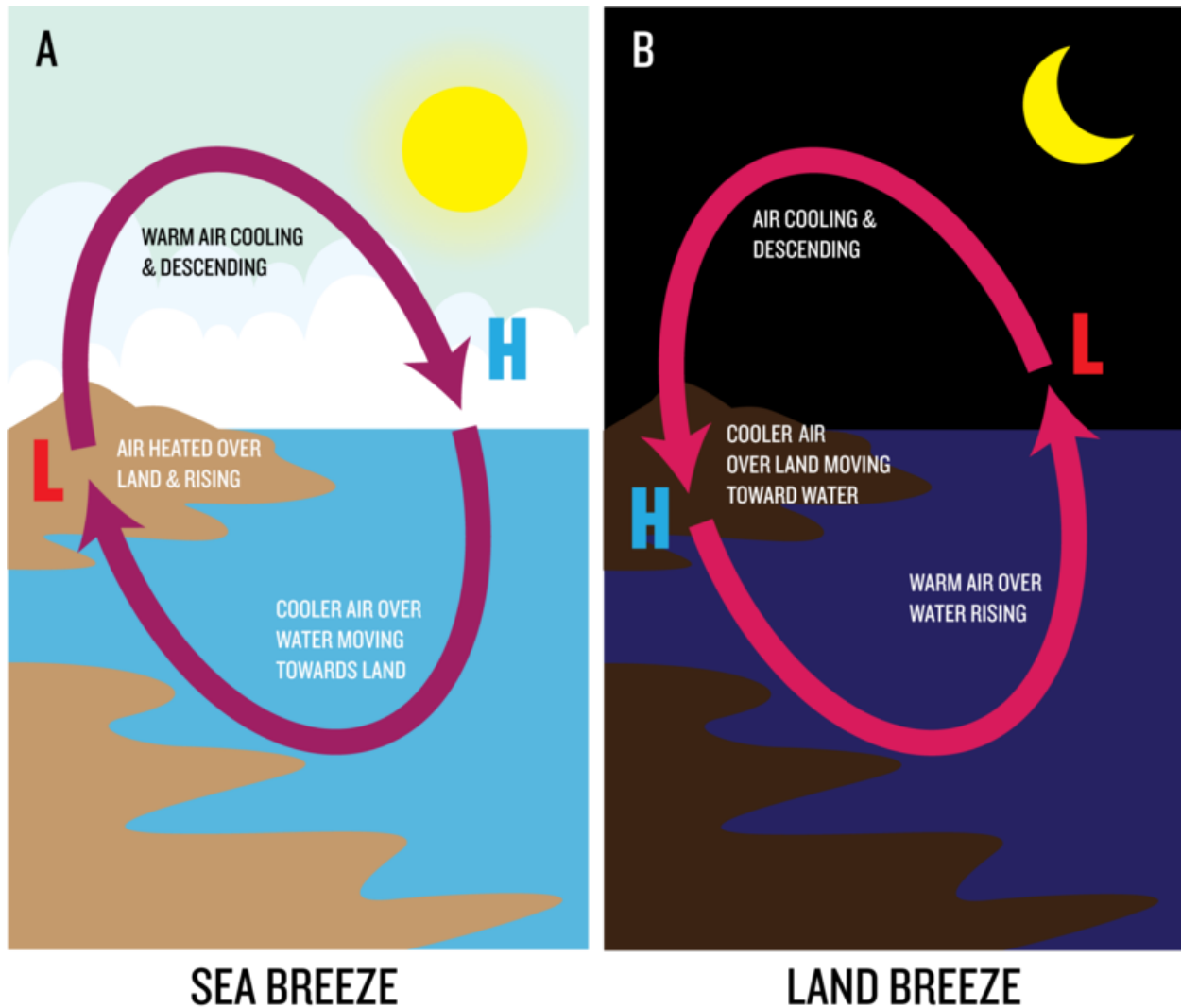
## Local Winds

**Local winds** are winds that blow over a limited area. They are influenced by local geography. Nearness to an ocean, lake or mountain range can affect local winds. Some examples are found below.

### Land and Sea Breezes

Ocean water is slower to warm up and cool down than land. So the sea surface is cooler than the land in the daytime. It is also cooler than the land in the summer. The opposite is also true. The water stays warmer than the land during the night and the winter. These differences in heating cause local winds known as land and sea breezes. Land and sea breezes are illustrated in **Figure 1.3**.

- A **sea breeze** blows from sea to land during the day or in summer. That's when air over the land is warmer than air over the water. The warm air rises. Cool air from over the water flows in to take its place.
- A **land breeze** blows from land to sea during the night or in winter. That's when air over the water is warmer than air over the land. The warm air rises. Cool air from the land flows out to take its place.

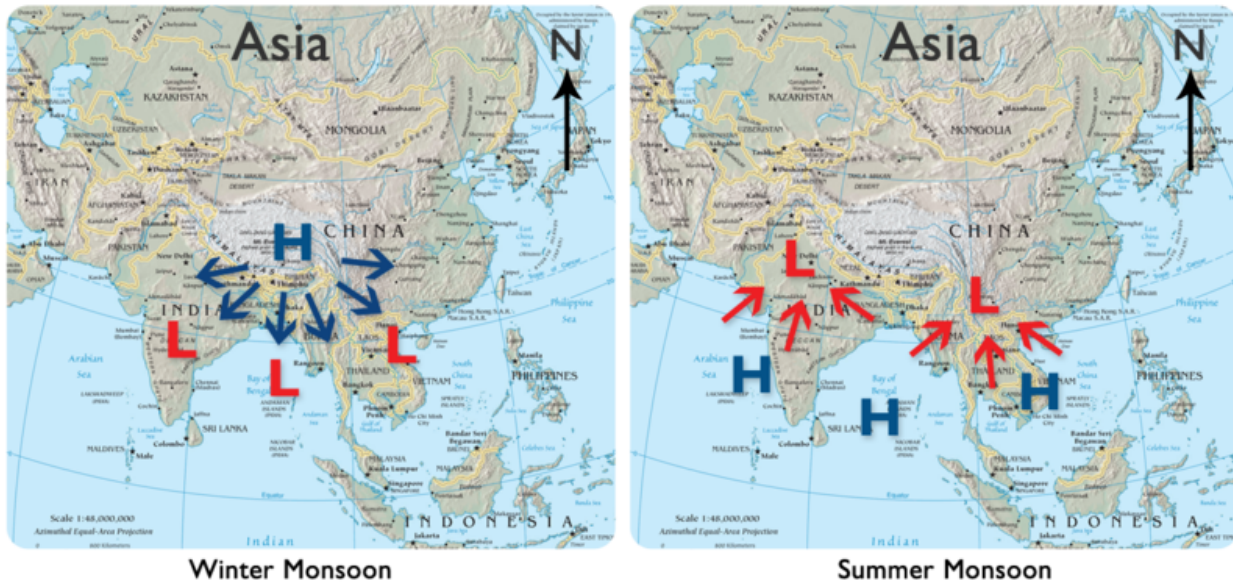


**FIGURE 1.3**

Land and sea breezes blow because of daily differences in heating.

## Monsoons

**Monsoons** are like land and sea breezes, but on a larger scale. They occur because of seasonal changes in the temperature of land and water. In the winter, they blow from land to water. In the summer, they blow from water to land. In regions that experience monsoons, the seawater offshore is extremely warm. The hot air absorbs a lot of the moisture and carries it over the land. Summer monsoons bring heavy rains on land. Monsoons occur in several places around the globe. The most important monsoon in the world is in southern Asia, as shown in **Figure 1.4**. These monsoons are important because they carry water to the many people who live there.

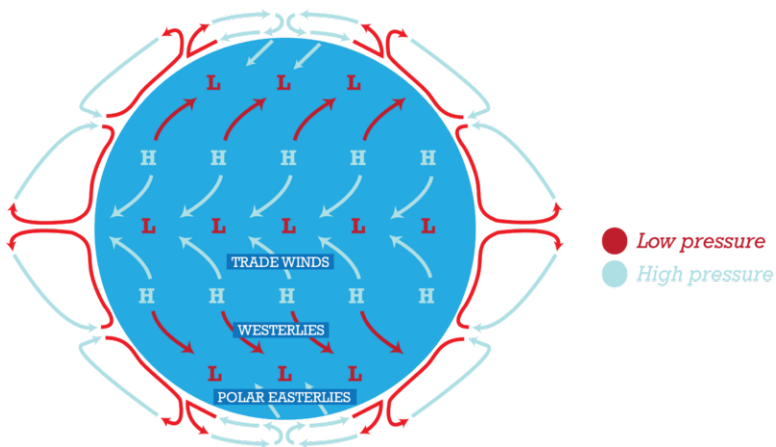


**FIGURE 1.4**

Monsoons blow over southern Asia.

## Global Winds

**Global winds** are winds that occur in belts that go all around the planet. You can see them in **Figure 1.5**. Like local winds, global winds are caused by unequal heating of the atmosphere.



**FIGURE 1.5**

Global winds occur in belts around the globe.

## Heating and Global Winds

Earth is hottest at the equator and gets cooler toward the poles. The differences in heating create huge convection currents in the troposphere. At the equator, for example, warm air rises up to the tropopause. It can't rise any higher, so it flows north or south.

By the time the moving air reaches 30° N or S latitude, it has cooled. The cool air sinks to the surface. Then it flows over the surface back to the equator. Other global winds occur in much the same way. There are three enormous convection cells north of the equator and three south of the equator.

## Global Winds and the Coriolis Effect

Earth is spinning as air moves over its surface. This causes the Coriolis effect. Winds blow on a diagonal over the surface, instead of due north or south. From which direction do the northern trade winds blow?

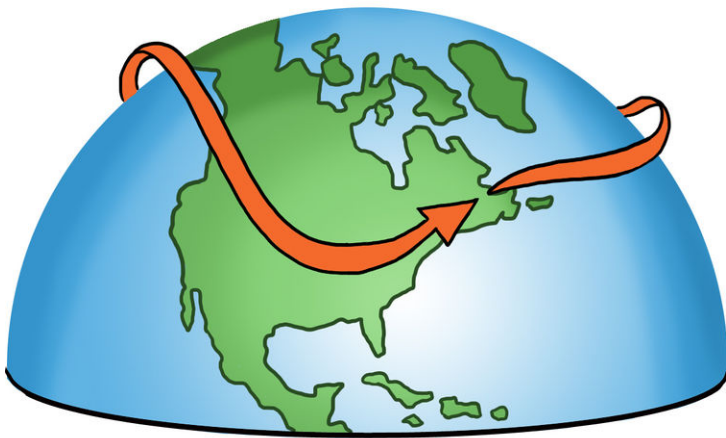
Without Coriolis Effect the global winds would blow north to south or south to north. But Coriolis makes them blow northeast to southwest or the reverse in the Northern Hemisphere. The winds blow northwest to southeast or the reverse in the southern hemisphere.

The wind belts have names. The Trade Winds are nearest the equator. The next belt is the westerlies. Finally are the polar easterlies. The names are the same in both hemispheres.

## Jet Streams

**Jet streams** are fast-moving air currents high in the troposphere. They are also the result of unequal heating of the atmosphere. Jet streams circle the planet, mainly from west to east. The strongest jet streams are the polar jets. The northern polar jet is shown in **Figure 1.6**.

### Northern Polar Jetstream



**FIGURE 1.6**

This jet stream helps planes fly quickly from west to east over North America. How do you think it affects planes that fly from east to west?

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## Lesson Summary

- Air movement takes place in the troposphere. Air moves because of differences in heating. The differences create convection currents and winds.
- Local winds are winds that blow over a limited area. They are influenced by local geography, such as nearness to an ocean. They include land and sea breezes as well as monsoons.
- Global winds occur in belts around the globe. They are caused by unequal heating of Earth's surface. The Coriolis effect causes global winds to blow on a diagonal over the surface. Unequal heating also causes jet streams high in the troposphere.

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## Lesson Review Questions

### Recall

1. Define wind.
2. What are local winds?
3. Describe monsoons.
4. Why are summer monsoons likely to bring heavy rains?
5. How does the Coriolis effect influence global winds?

### Apply Concepts

6. In **Figure 1.5**, find the global winds called prevailing westerlies. They blow over most the U.S. Apply lesson concepts to explain the direction these winds blow.

### Think Critically

7. Explain how differences in heating cause wind.
8. Compare and contrast land and sea breezes with monsoons.
9. If changes in the atmosphere caused the Indian Ocean to cool down, how would the people of southern Asia be affected? What might be the result?

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## Points to Consider

Temperature differences in the atmosphere cause winds. They also cause other weather conditions, such as clouds and rain.

- How do temperature differences cause clouds to form?
- How do they affect precipitation?



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## References

1. From left to right: Julian Lim (Flickr:julianlimjl); Nico Nelson; Euan Morrison (Flickr:ewan1234). From left to right: <http://www.flickr.com/photos/julianlim/4838480578/>; <http://www.flickr.com/photos/niconelson/4289796215/>; <http://www.flickr.com/photos/euanzkamera/7909241274/> . CC BY 2.0
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