SECTION 1

The Air Around You

DISCOVER ACTIVITY

How Long Will the Candle Burn?

1. Put on your goggles.
2. Stick a small piece of modeling clay onto an aluminum pie pan. Push a short candle into the clay. Carefully light the candle.
3. Hold a small glass jar by the bottom. Lower the mouth of the jar over the candle until the jar rests on the pie pan. As you do this, start a stopwatch or note where the second hand is on a clock.
4. Watch the candle carefully. How long does the flame burn?
5. Wearing an oven mitt, remove the jar. Relight the candle and then repeat Steps 3 and 4 with a larger jar.

Think It Over

Inferring How would you explain any differences between your results in Steps 4 and 5?

GUIDE FOR READING

- **How is the atmosphere important to living things?**
- **What gases are present in Earth's atmosphere?**

Reading Tip **Before you read, preview Figure 2. As you read, write a sentence about each of the major gases in the atmosphere.**

As you walk home from school, the air is warm and still. The sky is full of thick, dark clouds. In the distance you see a bright flash. A few seconds later, you hear a crack of thunder. As you turn the corner onto your street, raindrops start to fall. You begin to run and reach your home just as the downpour begins. That was close! From the shelter of the entrance you pause to catch your breath and watch the storm.

Importance of the Atmosphere

Does the weather where you live change frequently, or is it fairly constant from day to day? **Weather** is the condition of Earth's atmosphere at a particular time and place. But what is the atmosphere? Earth's **atmosphere** (AT muh sfeer) is the layer of gases that surrounds the planet. To understand the relative size of the atmosphere, imagine that the planet Earth is the size of an apple.

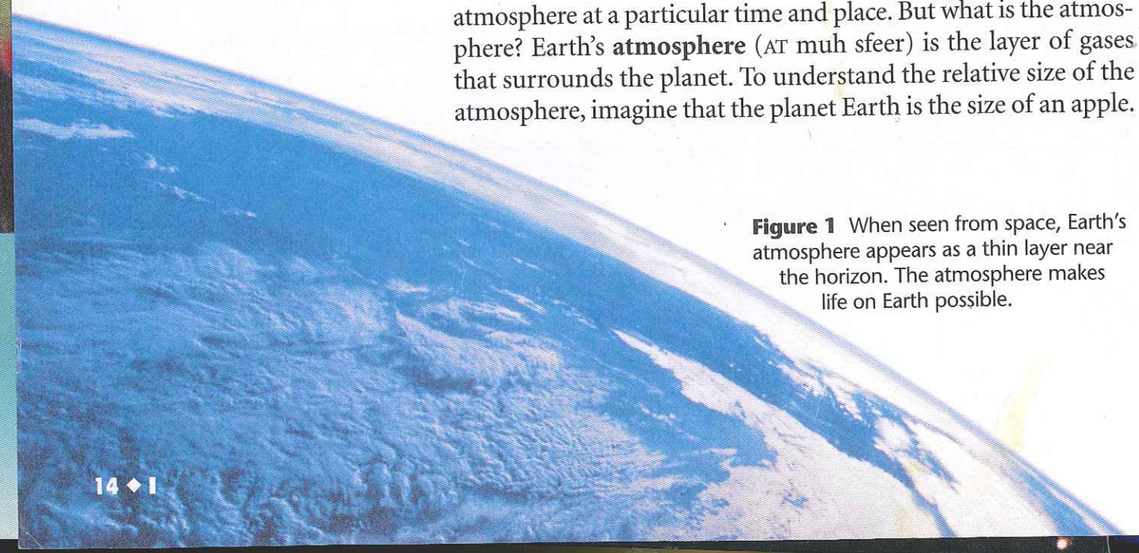


Figure 1 When seen from space, Earth's atmosphere appears as a thin layer near the horizon. The atmosphere makes life on Earth possible.

If you breathe on the apple, a thin film of water will form on its surface. Earth's atmosphere is like that water on the apple—a thin layer of gases on Earth's surface.

Earth's atmosphere makes conditions on Earth suitable for living things. The atmosphere contains oxygen and other gases that you and other living things need to live. In turn, living things affect the atmosphere. The atmosphere is constantly changing, with atoms and molecules of gases moving around the globe and in and out of living things, the land, and the water.

Living things also need warmth and liquid water. By trapping energy from the sun, the atmosphere keeps most of Earth's surface warm enough for water to exist as a liquid. In addition, Earth's atmosphere protects living things from dangerous radiation from the sun. It also prevents Earth's surface from being hit by most meteoroids, or chunks of rock from outer space.

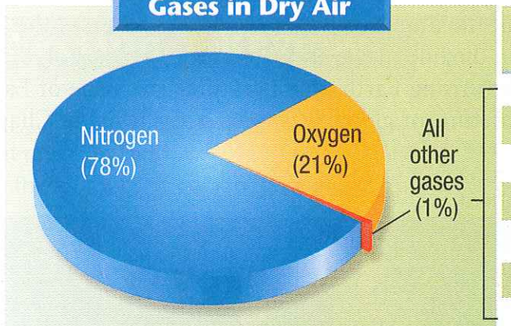
Checkpoint *What would conditions on Earth be like without the atmosphere?*

Composition of the Atmosphere

The atmosphere is made up of a mixture of atoms and molecules of different kinds of gases. An atom is the smallest unit of a chemical element that can exist by itself. Molecules are made up of two or more atoms. **Earth's atmosphere is made up of nitrogen, oxygen, carbon dioxide, water vapor, and many other gases, as well as particles of liquids and solids.**

Nitrogen As you can see in Figure 2, nitrogen is the most abundant gas in the atmosphere. It makes up a little more than three fourths of the air we breathe. Each nitrogen molecule consists of two nitrogen atoms.

Gases in Dry Air



Other Gases	Percentage by Volume
Argon	0.93
Carbon dioxide	0.036
Neon	0.0018
Helium	0.00052
Methane	0.00015
Krypton	0.00011
Hydrogen	0.00005

Figure 2 Dry air always has the same composition of gases.
Interpreting Data *What two gases make up most of the air?*

Language Arts CONNECTION

The word *atmosphere* comes from two Greek words: *atmos*, meaning "vapor," and *sphaira*, meaning "ball," or "globe." So the atmosphere is the vapors or gases surrounding a globe—in this case, Earth.

In Your Journal

As you read this chapter, write down all the words that end in *-sphere*. Look up the roots of each word in a dictionary. How does knowing the roots of each word help you understand its meaning?

TRY THIS

Breathe In, Breathe Out ACTIVITY

How can you detect carbon dioxide in the air you exhale?

1. Put on your goggles.
2. Fill a glass or beaker halfway with limewater.

3. Using a straw, slowly blow air through the limewater for about a minute. **CAUTION:** *Do not suck on the straw or drink the limewater.*
4. What happens to the limewater?

Developing Hypotheses What do you think would happen if you did the same experiment after jogging for 10 minutes? If you tried this, what might the results tell you about exercise and carbon dioxide?

INTEGRATING LIFE SCIENCE Nitrogen is essential to living things. Proteins and other complex chemical substances in living things contain nitrogen. You and all other organisms must have nitrogen in order to grow and to repair body cells.

Most living things cannot obtain nitrogen directly from the air. Instead, some bacteria convert nitrogen into substances called nitrates. Plants then absorb the nitrates from the soil and use them to make proteins. To obtain proteins, animals must eat plants or other animals.

Oxygen Each oxygen molecule has two oxygen atoms. Even though oxygen is the second-most abundant gas in the atmosphere, it makes up less than one fourth of the volume. Plants and animals take oxygen directly from the air and use it to release energy from food in a usable form.

Oxygen is also involved in other important processes. Any fuel you can think of, from the gasoline in a car to the candles on a birthday cake, uses oxygen as it burns. Without oxygen, a fire will go out. Burning uses oxygen rapidly. During other processes, oxygen is used slowly. For example, steel in cars and other objects reacts slowly with oxygen to form iron oxide, or rust.

Have you ever noticed a pungent smell in the air after a thunderstorm? This is the odor of ozone, which forms when lightning interacts with oxygen in the air. **Ozone** is a form of oxygen that has three oxygen atoms in each molecule instead of the usual two.

Carbon Dioxide Each molecule of carbon dioxide has one atom of carbon and two atoms of oxygen. Even though the atmosphere contains only a small amount of carbon dioxide, it is essential to life. Plants must have carbon dioxide to produce food. Animals, on the other hand, give off carbon dioxide as a waste product.

When fuels such as coal and gasoline are burned, they release carbon dioxide. Burning these fuels increases the amount of carbon dioxide in the atmosphere. Rising carbon dioxide levels may be raising Earth's temperature. The issue of Earth's rising temperature, or global warming, is discussed in Chapter 4.

Figure 3 To burn, these candles need oxygen, one of the gases in the atmosphere. ***Predicting*** *What would happen if the candles used up all of the oxygen around them?*

Other Gases Oxygen and nitrogen together make up 99 percent of dry air. Carbon dioxide and argon make up most of the other one percent. The remaining gases are called trace gases because only small amounts of them are present.

Water Vapor The composition of the air discussed so far has been for dry air. In reality, air is not dry because it contains water vapor. **Water vapor** is water in the form of a gas. Water vapor is invisible—it is not the same thing as steam, which is made up of tiny droplets of liquid water. Each water molecule contains two atoms of hydrogen and one atom of oxygen.

The amount of water vapor in the air varies greatly from place to place and from time to time. Air above a desert or polar ice sheet may contain almost no water vapor. In tropical rain forests, on the other hand, as much as five percent of the air may be water vapor.

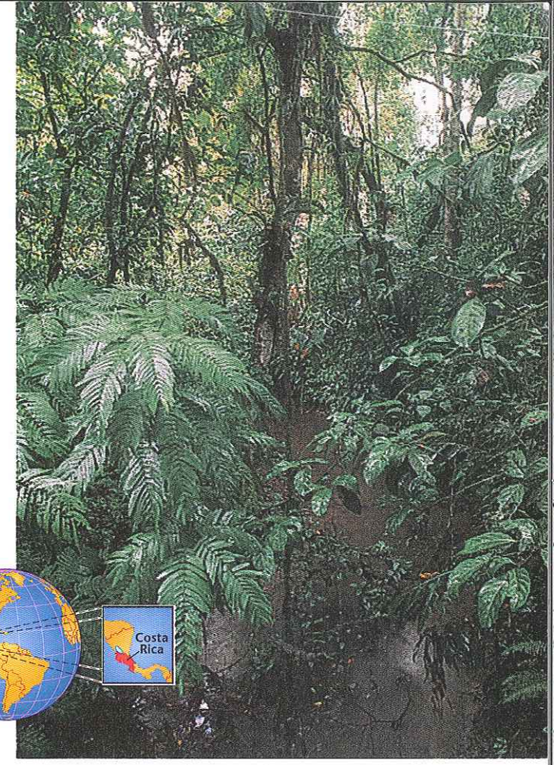


Figure 4 This lush vegetation grows in a rain forest in Costa Rica. The percentage of water vapor in the air in a rain forest may be as high as five percent.

Water vapor plays an important role in Earth's weather. Clouds form when water vapor condenses out of the air to form tiny droplets of liquid water or crystals of ice. If these droplets or crystals become large enough, they can fall as rain or snow.

Particles Pure air contains only gases. But pure air exists only in laboratories. In the real world, air also contains tiny solid and liquid particles of dust, smoke, salt, and other chemicals. Sometimes you can see particles in the air around you, but most of them are too small to see.

Section 1 Review

1. Describe two ways in which the atmosphere is important to life on Earth.
2. What are the four most common gases in dry air?
3. Why are the amounts of gases in the atmosphere usually shown as percentages of dry air?
4. **Thinking Critically** **Applying Concepts** How would the amount of carbon dioxide in the atmosphere change if there were no plants? If there were no animals?

Check Your Progress

CHAPTER PROJECT 1

Have you determined *how, where,* and *when,* you will make your observations? Organize a notebook to record them. Think of ways to compare weather conditions from day to day. Make your observations without weather instruments or TV weather reports. (*Hint:* You can estimate how much of the sky is covered by clouds.) For your own safety, do not try to make observations during storms.