74 As Earth Rotates

READING

Although the changing position of the Sun throughout the day makes it look like the Sun is moving, you now know that it is really Earth that moves. The rotation of Earth around its axis causes the 24-hour cycle of day and night.

CHALLENGE

What effect does the rotation of Earth have on the way people measure time?

This photograph taken from space shows the light and dark sides of Earth and the Moon.

MATERIALS

For each student

- **1 Student Sheet 74.1, "Anticipation Guide: As Earth Rotates"**
- **1 Student Sheet 71.1b, "My Ideas About the Day, Year, Seasons, and Moon Phases: After"**

READING

Use Student Sheet 74.1, "Anticipation Guide: As Earth Rotates," to help prepare you for this reading.

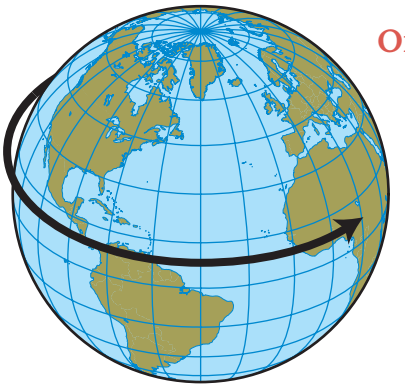

Figure 1: Earth's Rotation
The globe rotates counterclockwise when viewed from above the Northern Hemisphere.

One Day–Night Cycle is One Complete Rotation of Earth

Every 24 hours, Earth **rotates,** or turns around its axis. The **axis** is an imaginary line through the center of Earth, from the North Pole to the South Pole. One complete turn of Earth is called a **rotation** (row-TAY-shun). You can simulate this movement by slowly spinning a globe on its stand. If you look down onto the North Pole at the top of the globe, you should spin the Earth counterclockwise, as shown in Figure 1 at left.

At sunrise where you live, you see the Sun coming up on the eastern horizon as your region of Earth rotates into the light from the Sun. Then the Sun appears to move across the sky from east to west, until it sets. Figure 2 below shows approximately where the Sun appears in the sky during a typical day in most of the United States in early spring and early fall. In spring and fall, day and night are about equal in length, at 12 hours each.

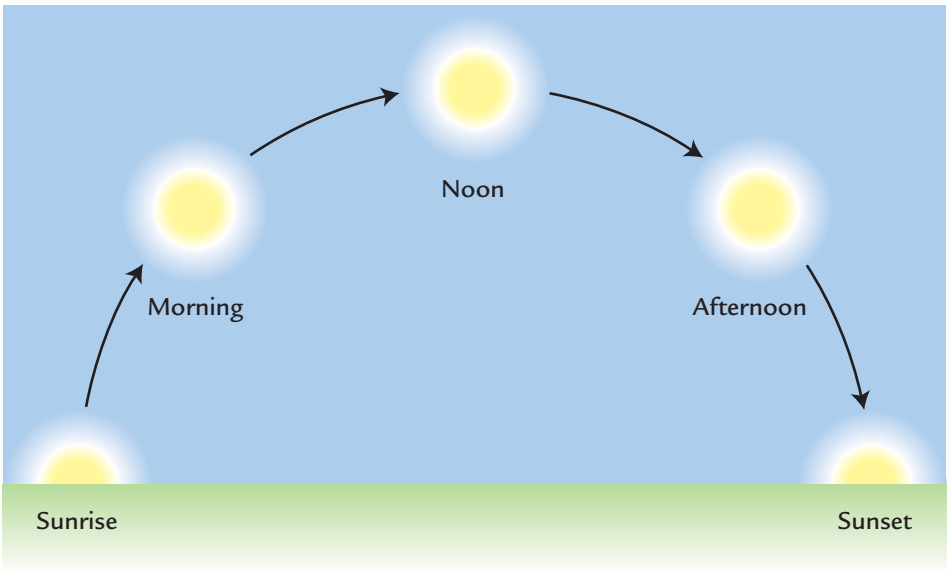

Figure 2: The Sun's Position in the Sky
If you face south on a spring day, you will see the Sun in different positions at different times of the day.

Using the Sun to Make a Clock

You observed that the shadow from your sun stick moved in the same direction as the hands on a clock, or "clockwise." You may not have realized it, but your sun stick observations are a lot like methods people used to measure time long ago.

Researchers think that ancient peoples in Africa and the Middle East put sticks into the ground and scratched marks in the ground to track the movement of the shadow cast by the stick. This would have shown the passage of time during the day—that's just what a clock does.

Eventually, people began to build structures for keeping time. As early as 5,000 years ago, the Egyptians built tall stone towers called obelisks. Some people think they used the obelisks' shadows to show the time of day. Sometime after that, sundials were invented, probably in many places by different cultures. Although we can't say for sure who first invented sundials, the earliest known sundial was found in Egypt and was made about 3,500 years ago.

Like sun sticks, sundials use shadows to indicate the time, as shown in Figure 3. Each sundial has an upright piece that casts a shadow on a disc marked with the hours of the day. The shadow from a stick or on

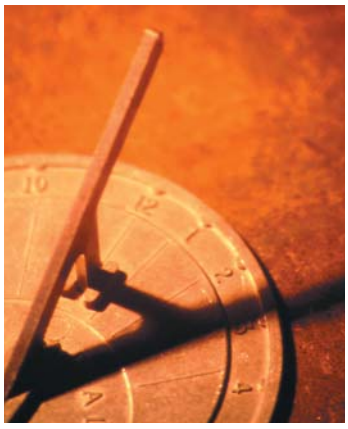

Figure 3: Examples of Sundials
The shadow cast onto each of these sundials indicates the time.

a sundial is shortest at noon, when the Sun is at its highest point in the sky. The direction of the sundial shadow changes just as your sun stick shadow does. In the Northern Hemisphere, the shadow moves across a sundial from morning to night. The clockwise movement of the shadow is no coincidence: inventors arranged the hands and hours on clocks to imitate the movement of the shadow and the hour marks on a sundial. Sundials are no longer used to keep time, but you might see them in special places in gardens and parks.

Earth's Rotation and Time Zones

Every day in the United States, the Sun shines first on East Coast cities such as New York and Miami. It takes about three more hours for Earth to rotate enough to move West Coast cities like Seattle and Los Angeles into the sunlight. That's why sunrise on the East Coast is about three hours earlier than sunrise on the West Coast.

Until the mid-1800s, cities and towns kept their own time. For each of them noon was the exact time when the Sun reached its highest point in the sky. This meant that when the clocks in one town read exactly 12:00, the clocks in a town 50 miles to the east might have read 12:03. As train travel became common, these time differences began to confuse everyone. With each town using its own local time, scheduling arrival and departure times was very complicated. And the train engineers and conductors had to keep resetting their watches to the correct local time. Something had to be done to standardize the time of day.

First, each railroad company used its own standard time for its train schedules. That meant its time didn't match local times or times for other railroads' trains. Passengers kept missing their trains, and trains crashed into each other, too. The answer to this problem was time zones. A **time zone** is an area of the world where all clocks are set to the same time. The maps in Figure 4 on the next page show the time zones for the whole world and a close-up view of the U.S. time zones. Earth is divided into 24 major time zones, because it takes 24 hours for Earth to make a complete rotation around its axis. In 1883, all the railroads divided the United States into four time zones to make a single system of standard time that was known for many years as "railroad time." When it is noon everywhere in the Eastern Time Zone, it is only 9 a.m. everywhere in the Pacific Time Zone. It's even earlier in most of Alaska and Hawaii and midnight in some parts of Asia.

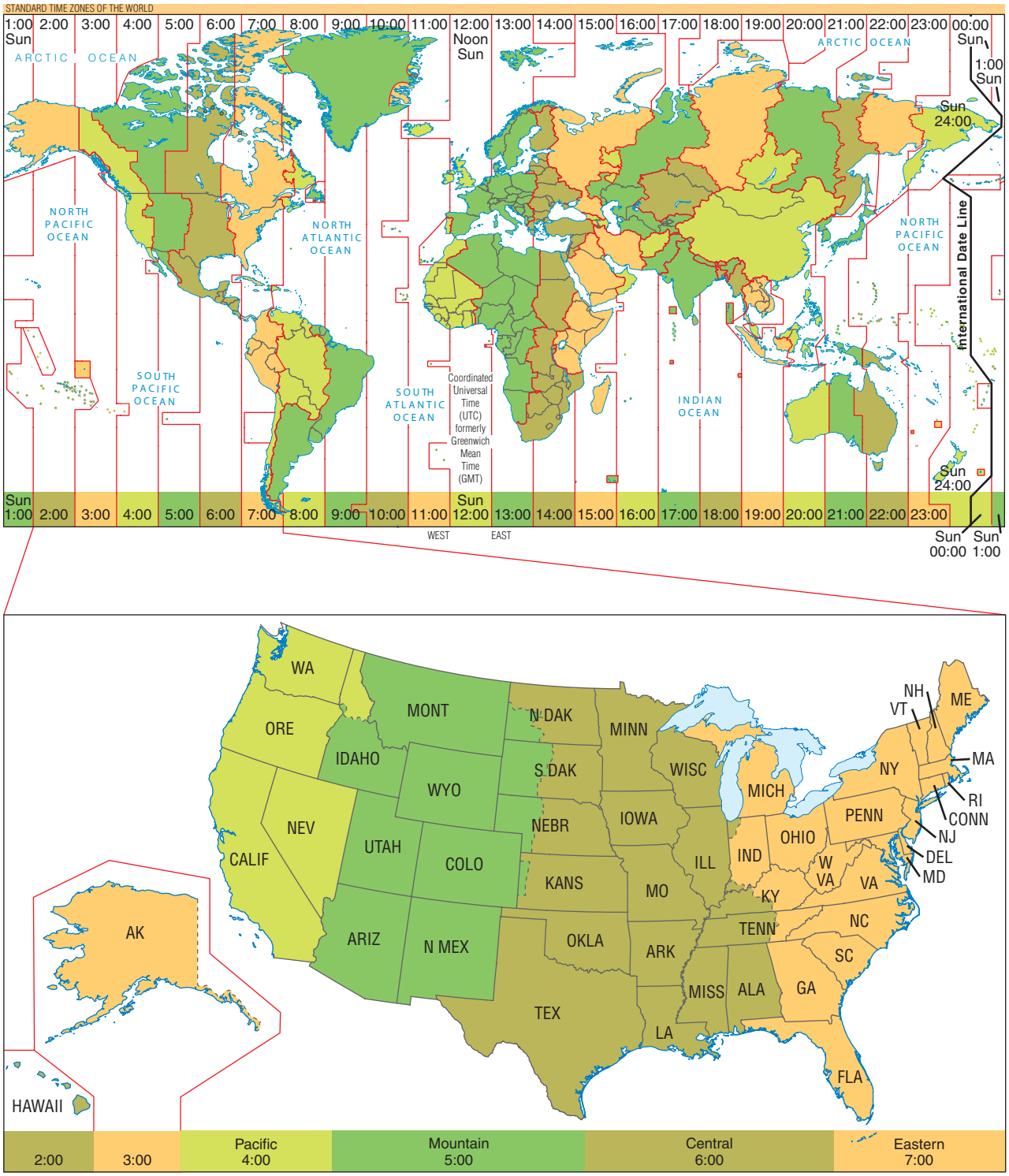

Figure 4: Time Zone Maps

The map at the top shows time zones of the world. The map below it shows those of the United States.

ANALYSIS

1. In the United States, in what direction does the shadow from a stick or sundial point at each of the following times:
   a. at noon?
   b. in the morning?
   c. in the afternoon?

2. How does a sundial show the time?
3. Why is the world divided into time zones?
4. Why weren't time zones created until the late 1800s?
5. When it is 5 p.m. in the Eastern Time Zone, what time is it in the Mountain Time Zone?
6. **Reflection:** How have your ideas about the cause of Earth's day–night cycle changed since you began this unit?

EXTENSION

Go to the *Issues and Earth Science* page of the SEPUP website for links to information about ancient structures used to mark the movement of the Sun during the day and for instructions on how to make your own sundial.