LEARN ABOUT

The Cycles of Planets

FIND OUT

- how the planets move on their axes
- how the planets move around the sun

VOCABULARY

rotation
axis
revolution
orbit
ellipse

Planets Rotate on Their Axes

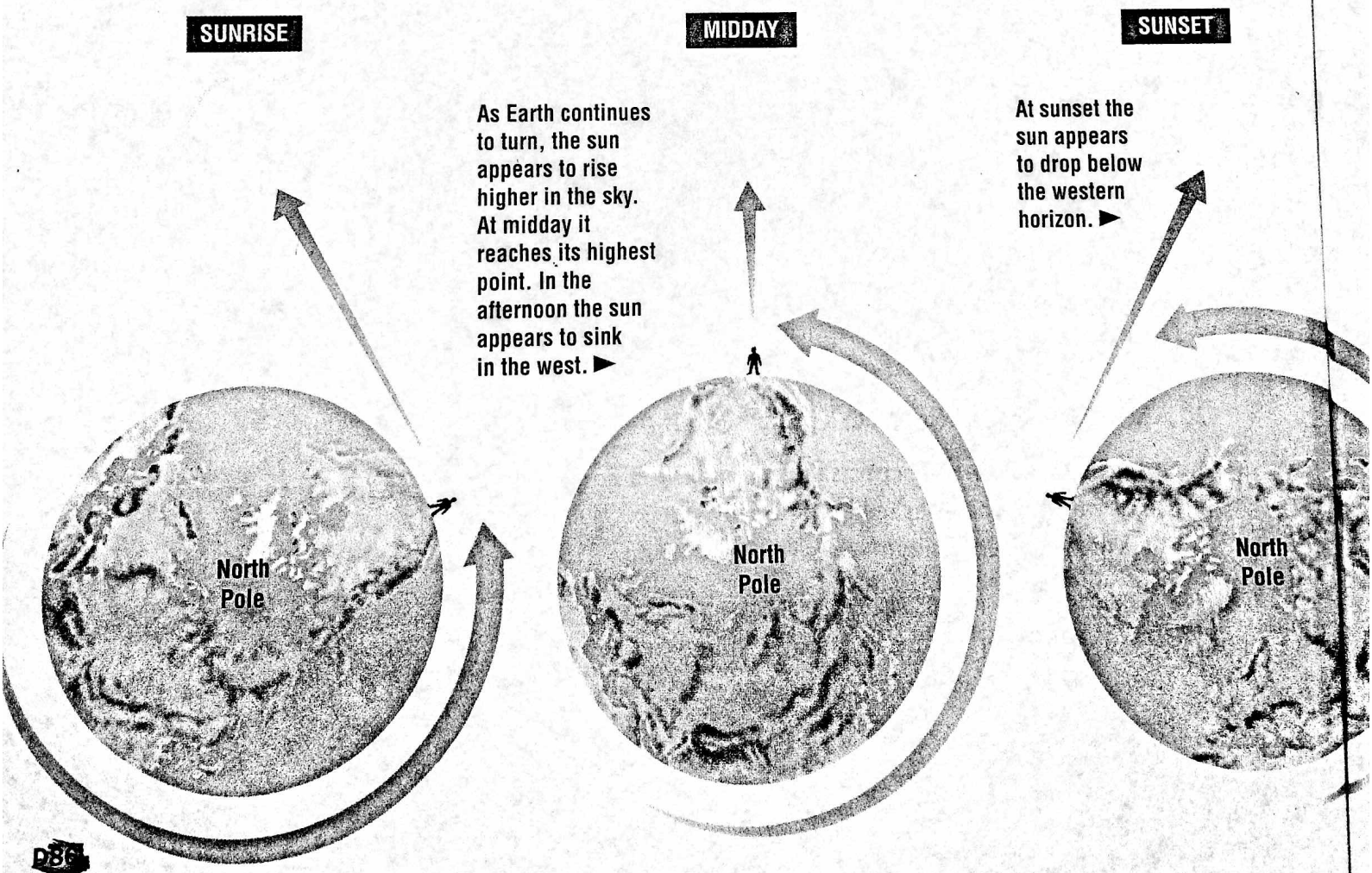
Suppose there were a world in which the sun shone for 6 months followed by 6 months of darkness. If you woke up to a gray dawn, it could be weeks before the sky was bright. That is what a day on Earth would be like if the planet did not spin, or rotate.

Earth has a day that lasts about 24 hours because of the planet's rotation. **Rotation** is the turning of an object on an axis. Earth's **axis** is an imaginary line through the planet's center, from the North Pole to the South Pole. Because Earth rotates, locations on its surface move from daylight to darkness and back to daylight again. The half of Earth facing the sun is in sunlight and has day. The half of Earth facing away from the sun is in darkness and has night.

All planets rotate on their axes, as Earth does. But each planet rotates at a different speed. The amount of time it takes for a planet to complete one rotation is its *period of rotation.*

✓ **What is rotation?**

Earth rotates from west to east. At dawn your location moves toward the sun's light. The sun appears to rise above the eastern horizon. ▼



Days and Years

You think of a day as 24 hours, the length of a day on Earth. But because the planets in the solar system have different periods of rotation, each planet has a day of a different length. Jupiter has the shortest day of all the planets. It rotates in 9.8 hours, so its day is just that long. You could spend two full days on Jupiter in less than one Earth day! On the other hand, Venus has a day that lasts 117 Earth days. In one day on Venus, about one-third of an Earth year would pass. As you can see on the chart, the lengths of the planets' days do not form a pattern.

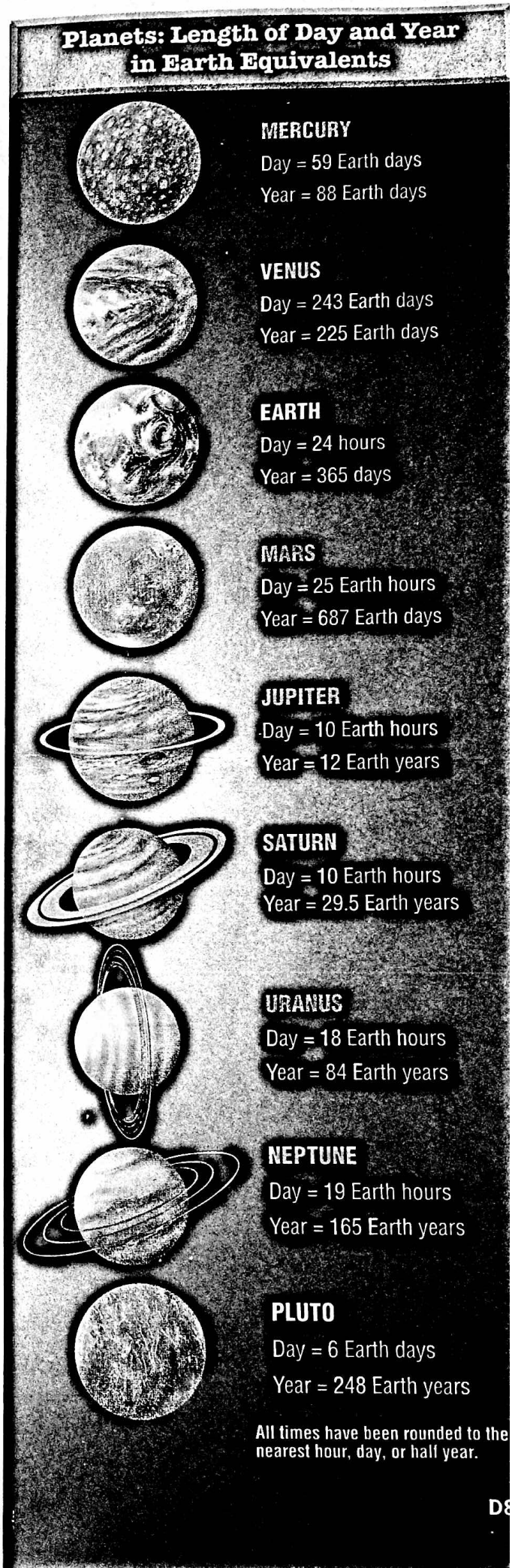
As a planet rotates on its axis, it also revolves around the sun. **Revolution** is the movement of one object in an orbit around another object. An **orbit** is the path an object follows as it revolves around another object. In the investigation you saw that orbits are elliptical. An **ellipse** is an oval path.

The length of time that a planet takes to complete one revolution around the sun is a year. Because the planets' periods of revolution differ, their years differ. The length of Earth's year is $365\frac{1}{4}$ days. You can see in the chart that the lengths of the planets' years vary widely.

A planet's year depends on its distance from the sun. Johannes Kepler, who discovered that the planets have elliptical orbits, also discovered that the speed of a planet in orbit decreases as the distance from the sun increases. So the planets farthest from the sun cover the greatest distance in orbit but move the slowest.

Mercury, the closest planet to the sun, has the shortest year because it moves around the sun the fastest and has the shortest distance to travel. Pluto, the planet usually farthest from the sun, takes about 248 Earth years to make one revolution.

✓ **What is planetary revolution?**



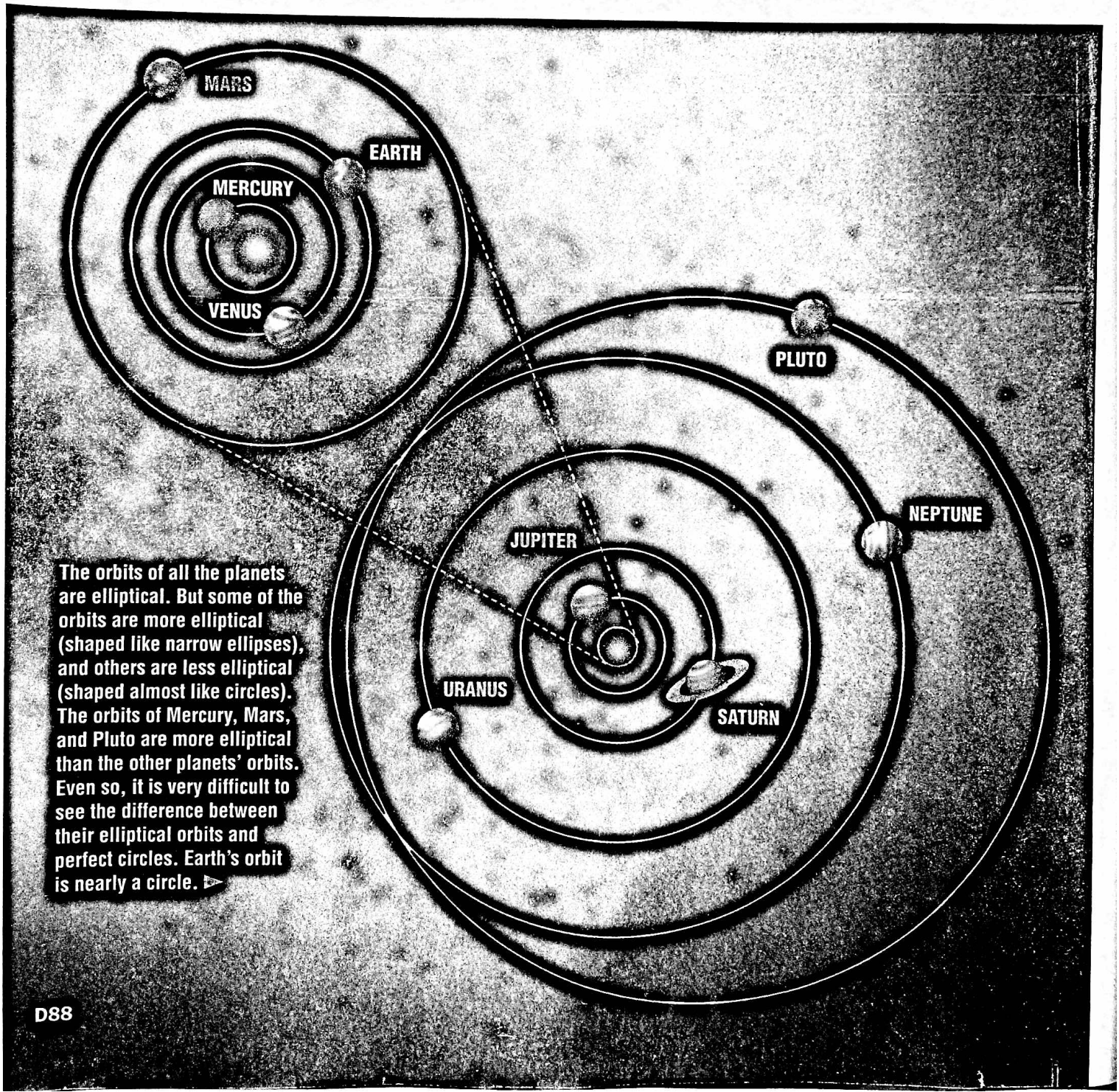
Orbits and Seasons

If you could look at a planet's orbit from above, you would see that the sun is not at the center of the ellipse. The sun is at one focus of the ellipse, slightly away from the center.

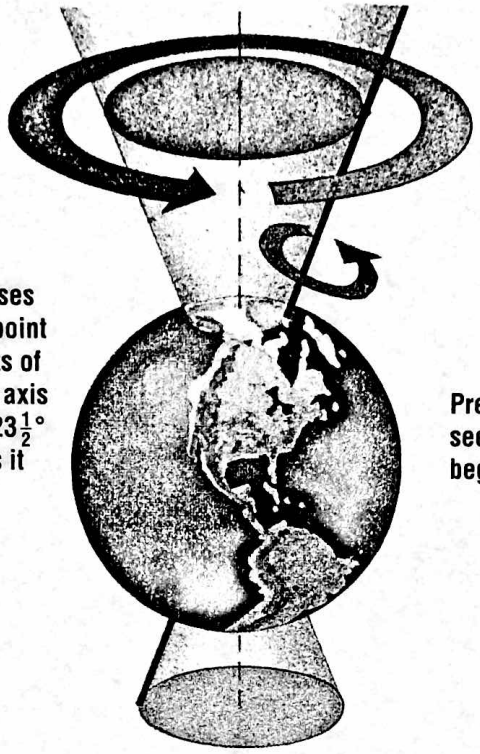
Because planetary orbits are elliptical, each planet is closer to the sun at some times than at others. The point in orbit where a planet is closest to the sun is called *perihelion* (pair•ih•HEE•lee•uhn). The point where the planet is farthest from the sun is called *aphelion* (ap•HEE•lee•uhn).

Earth has different seasons as it revolves around the sun. But Earth's changing distance from the sun does not cause seasonal temperature changes. In fact, Earth is closest to the sun in mid-winter in North America. It is then 5 million km (about 3 million mi) closer to the sun than in summer.

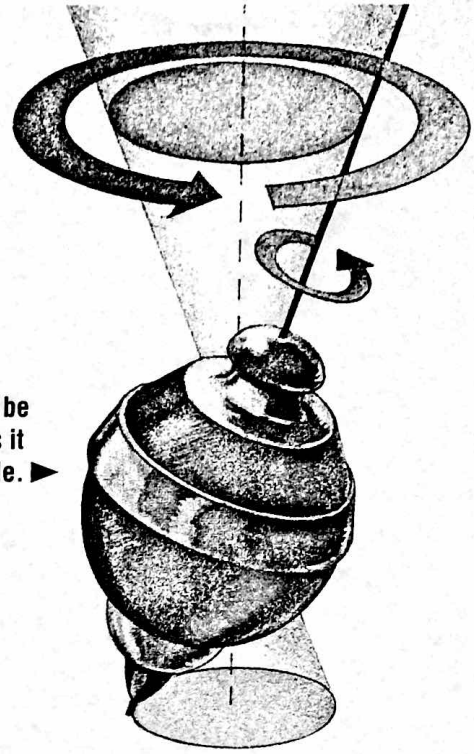
✓ **Where is the sun with respect to the shape of the planets' orbits?**



The orbits of all the planets are elliptical. But some of the orbits are more elliptical (shaped like narrow ellipses), and others are less elliptical (shaped almost like circles). The orbits of Mercury, Mars, and Pluto are more elliptical than the other planets' orbits. Even so, it is very difficult to see the difference between their elliptical orbits and perfect circles. Earth's orbit is nearly a circle.



Precession causes Earth's axis to point to different parts of the sky. Earth's axis remains tilted $23\frac{1}{2}°$ from vertical as it wobbles. ►



Precession can be seen in a top as it begins to wobble. ►

Planets Wobble on Their Axes

Earth rotates and revolves fairly fast. But a third movement of Earth is very slow. If you have ever spun a top, you know that it stands straight up and down when it is spinning fast. As the top slows, it starts to wobble.

The Earth wobbles like a top—just not as quickly. In 26,000 years, the Earth makes one huge wobble. The poles slowly trace huge circles. This wobble is called *precession.*

Because the wobble is so slow, people don't see its effects in one lifetime. But the effects are clear over thousands of years. One important long-term effect of precession is that Earth's axis at the North Pole points at different stars in the night sky.

In the Northern Hemisphere, Earth's axis now points to a star called Polaris. For this reason, Polaris is also called the North Star. Because of its location, Polaris doesn't seem to move as Earth rotates. It appears to stay in one spot, while all the other stars appear to move in circles around it. Because Polaris appears fixed, navigators have used it for hundreds of years to find their position. The angle made by Polaris and the horizon shows latitude.

During Earth's slow wobble, the North Star changes. At the time of the ancient Egyptians, in 2700 B.C., the North Star was Thuban. Thuban is in the constellation Draco, the dragon. Twelve thousand years from now, the North Pole of the axis will be on the other side of its precession circle. At that time, the axis will point to a place very near a bright star named Vega.

✓ **What is precession?**

The North Star and Precession of Earth

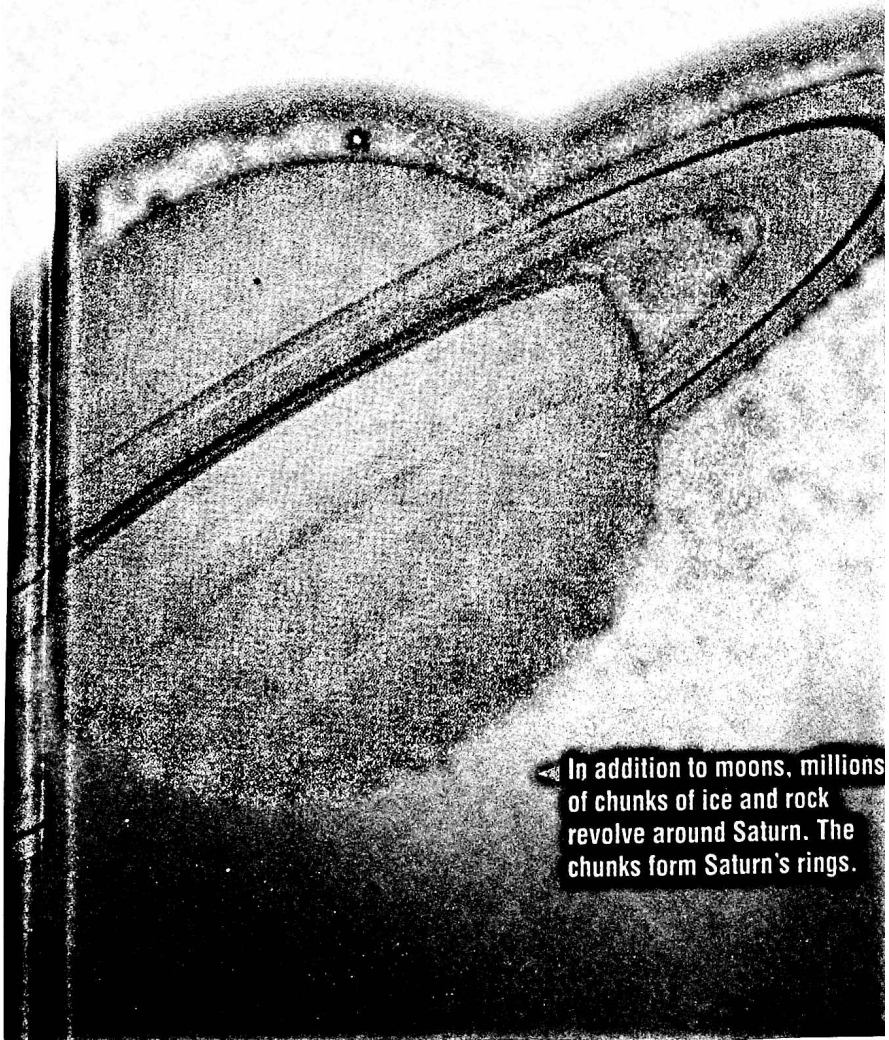
	2700 B.C.	A.D. 2000	A.D. 14,000	A.D. 23,000	A.D. 28,000
Vega			North Star		
Polaris		North Star			North Star
Thuban	North Star			North Star	

Summary

All planets rotate on their axes. One rotation defines a day. Planets revolve around the sun in elliptical orbits. One revolution defines a year. The length of days and years differs for the different planets of the solar system.

Review

1. What is a planet's revolution?
2. What is aphelion?
3. What is perihelion?
4. **Critical Thinking** How would Earth's year be different if it were farther from the sun? Explain your answer.
5. **Test Prep** Precession causes Earth to wobble slowly on its —
   - **A** poles
   - **B** equator
   - **C** orbit
   - **D** axis



In addition to moons, millions of chunks of ice and rock revolve around Saturn. The chunks form Saturn's rings.