



FIGURE 2.19 **MA** **INTERACTIVE FIGURE**

Precession affects the orientation of a spinning object's axis, but not the amount of its tilt.

we see at those times. For example, a couple thousand years ago the June solstice occurred when the Sun appeared in the constellation Cancer, but it now occurs when the Sun appears in Gemini. This explains something you can see on any world map: The latitude at which the Sun is directly overhead on the June solstice ($23\frac{1}{2}^{\circ}\text{N}$) is called the *Tropic of Cancer*, telling us that it was named back when the Sun appeared in Cancer on this solstice.

Precession is caused by gravity's effect on a tilted, rotating object. A spinning top precesses because Earth's gravity tries to pull over its lopsided, tilted spin axis. Gravity does not succeed in pulling it over—at least until friction slows the rate of spin—but instead causes the axis to precess. The spinning Earth precesses because gravitational tugs from the Sun and Moon try to “straighten out” our planet's bulging equator, which has the same tilt as the axis. Again, gravity does not succeed in straightening out the tilt but only causes the axis to precess.

MA Phases of the Moon Tutorial, Lessons 1–3

2.3 The Moon, Our Constant Companion

Aside from the Sun, the Moon is the brightest and most noticeable object in our sky. The Moon is our constant companion in space, traveling with us as we orbit the Sun.

• Why do we see phases of the Moon?

As the Moon orbits Earth, it returns to the same position relative to the Sun in our sky (such as along the Earth–Sun line) about every 29½ days. This time period marks the cycle of **lunar phases**, in which the Moon's

common misconceptions

Sun Signs

You probably know your astrological “Sun sign.” When astrology began a few thousand years ago, your Sun sign was supposed to represent the constellation in which the Sun appeared on your birth date. However, because of precession, this is no longer the case for most people. For example, if your birthday is March 21, your Sun sign is Aries even though the Sun now appears in Pisces on that date. The problem is that astrological Sun signs are based on the positions of the Sun among the stars as they were almost 2000 years ago. Because Earth's axis has moved about 1/13 of the way through its 26,000-year precession cycle since that time, astrological Sun signs are off by nearly a month from the actual positions of the Sun among the constellations today.