

Getting to Know: Tides

How do you feel when you see a full moon? Although it happens every month, all year long, people still find the patterns of the moon's movement interesting. However, the moon does more than simply reflect light back to Earth at night. The moon plays an important role in some of the patterns that occur here on our planet, too.

Gravitational attraction holds the moons and planets in their orbits. Although you cannot see the force of gravity that holds the moon in its orbit, you can see the effects of the gravitational attraction between the moon and Earth every day. That is because the tides result from gravitational attraction among the moon, Earth, and Sun. The gravitational pull of the moon is the primary cause of tides on Earth. The Sun also influences tides, but to a lesser extent than the moon does.



A boat rests on a beach during low tide. When high tide occurs, the boat will be floating in the water.

What causes the tides?

Tides are caused when the gravitational attraction of the moon and the Sun cause the sea level to rise in certain areas of Earth's surface. A *tidal bulge* forms as water in the ocean basin sloshes toward the moon's gravitational pull. The water on the opposite side of Earth from the moon also bulges, although to a lesser extent. A high tide forms where the tide bulges toward the moon. At the same time, two low tides occur in the areas that ocean water has flowed away from.

The topography of the shore also affects tides. For instance, the Bay of Fundy, between Maine and Canada, experiences some of the highest and lowest tides in the world. Because of the Bay's unique shape, the tides can cause sea level in the Bay to vary by up to 53 feet!

The moon is much smaller than the Sun. Why does the moon have a greater influence on tides than the Sun does?

Gravitational attraction is the force that keeps your feet solidly planted on Earth. The strength of the gravitational attraction between objects depends on their mass and their distance apart. The Sun is very large and has more mass than Earth, but it is very far away. The moon is smaller than Earth, but it is much closer than the Sun. Therefore, the moon exerts a greater gravitational pull on Earth's surface than the Sun does.



Misconception 1: *Tides only occur on the side of Earth nearest the moon.*

A tidal bulge is similar to a long-period ocean wave that peaks near the side of Earth facing the moon. The opposite side of Earth, however, also experiences a high tide at the same time.

How often do tides occur?

Most places on Earth experience two high tides and two low tides each day. The water level rises and falls at very predictable rates. In fact, tide tables are schedules of tidal variations used by boaters to predict the incoming tide. An area that has a low tide twice daily will find both low tides arriving 50 minutes later during each 24-hour period. High tides also occur 50 minutes later during each 24-hour period.

Are moon phases associated with tides?

The phases of the moon are associated with tidal variation. That is because the position of the Sun, Earth, and moon relative to each other affects the size of tides. *Spring tides* occur as the Earth, Sun, and moon are aligned during the full and new moon phases. Spring tides are higher than normal tides. During a spring tide, the gravitational attraction of the Sun is combined with the gravitational attraction of the moon, causing the tides to be higher and lower than normal.

Neap tides occur when the moon is in the first and third quarter phases. In the first and third quarter, the moon and Sun are in opposition. The gravitational attraction of the Sun counteracts the effects of the moon's gravitational attraction. This causes tidal variation to be less extreme, making neap tides less intense than spring tides.



To help show the height of high and low tides, a *tide gauge* indicates the maximum and minimum water levels.



Misconception 2: *Does the rotation of the Sun or moon affect tides?*

The rotation of the Sun and moon does not affect the tides. Although the rotation of astronomical bodies is not a factor that influences tidal forces, Earth's rotation does determine where and when a tidal bulge appears. However, Earth's rotation does not affect the strength of the tidal force itself.

Even if you do not visit the seashore often, next time you look up at the moon you might think about it differently. The only natural satellite orbiting Earth, the moon, really does affect the tides and other patterns that occur on our planet.