What causes the tides in the ocean?

By NASA and NOAA, adapted by Newsela staff on 02.09.17
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Flying gulls on Morro Strand State Beach, California, at low tide. Morro Rock is seen in the background. Photo taken January 21, 2012, by Mike Baird. Originally posted to Flickr, licensed under Creative Commons. MIDDLE: Graphic showing the moon's gravitational pull. BOTTOM: The tidal range.

High tides and low tides come and go, as the level of the sea goes up and down. This cycle of two high tides and two low tides happens most days on coastlines around the world.

Why Is That?

Tides are really all about gravity. When we're talking about the daily tides, it's the moon's gravity that's causing them.

As Earth rotates, the moon's gravity pulls on different parts of our planet. The moon is much smaller than Earth, so its gravity is much less than Earth's gravity. However, since the moon is so close to us, it has enough gravity to move things around. The moon's gravity even pulls on the land, but not enough for anyone to really tell.

When the moon's gravity pulls on the water in the oceans, however, someone's bound to notice. Water, being a liquid, has a much easier time moving around. It bulges toward the moon, and that bulge follows the moon as Earth turns beneath it.

That explains the first high tide each day, but what about the second high tide?

The ocean also bulges out on the side of Earth opposite the moon.

Wait, What?

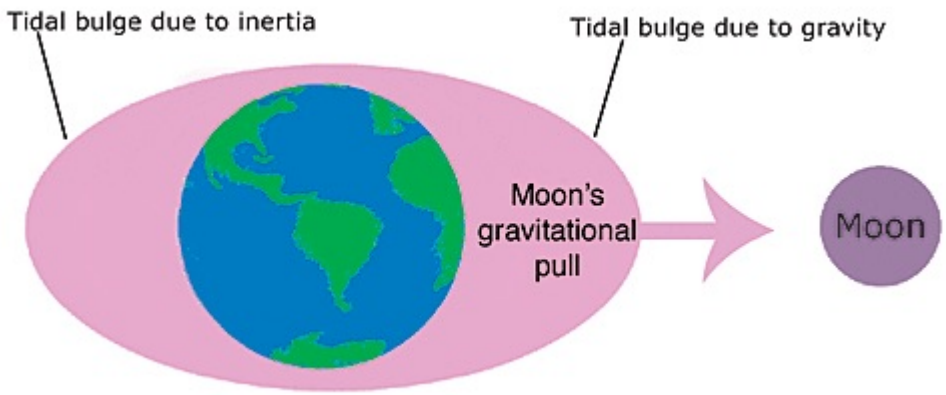
If the moon's gravity is pulling the oceans toward it, how can the ocean also bulge on the side of Earth away from the moon?

Gravity is the major force causing tides, but inertia is playing a part too. Inertia is a resistance against change in direction. It acts to balance out the force of gravity. Inertia causes moving objects to continue moving in a straight line. It wants to keep doing whatever it's doing, whether that's moving in a straight line or staying still, until another force acts on it.

While the water closest to the moon is getting pulled, the water farthest from the moon is staying right where it is. Both sides are experiencing gravity and inertia, but one always overpowers the other.

On the side by the moon, gravity wins. On the side away from the moon, inertia wins.

These two bulges explain why there are two high tides and two low tides each day.



Are Tides The Same Height Everywhere On The Planet?

The high and low tides are not the same height everywhere on the planet.

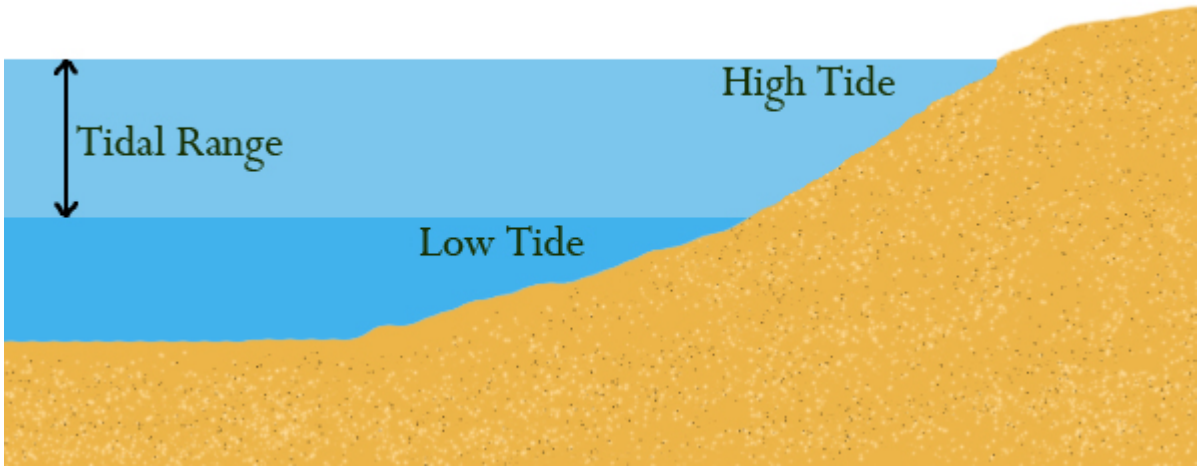
If Earth were perfectly round and completely covered in water, then high and low tides would be equally proportioned everywhere. But Earth is not a perfect sphere, and there are big continents getting in the way of water bulging in the direction of the moon. That's why in some places, the difference between high and low tide isn't very big. In other places, the difference is huge.

High And Low Tides

Tides begin in the oceans as waves. Then they move toward the coastlines, where they appear as the regular rise and fall of the sea surface. When the highest part of the wave, or its crest, reaches a particular location, high tide occurs. Low tide corresponds to the lowest part of the wave, or its trough.

Most coastal areas experience two high tides and two low tides every day. But, they are affected by the lunar day, not the solar day. Everyone knows the 24-hour solar day. This is the time it takes for the Earth to rotate about its axis so that the sun appears in the same position in the sky. A lunar day is the time it takes for the moon to make one complete orbit around the Earth and come back to the same position. This takes 24 hours and 50 minutes, slightly longer than a solar day.

The Earth rotates through two tidal "bulges" every lunar day. This means that every 24 hours and 50 minutes coastal areas experience two high tides and two low tides. High tides occur 12 hours and 25 minutes apart. It takes six hours and 12.5 minutes for the water at the shore to go from high to low, or from low to high.



Does Anything Else Affect Tides?

The sun has a part to play in tides as well. For instance, when the sun’s gravitational pull lines up with the moon’s gravitational pull, the tides are more extreme.

Wind and weather patterns also can affect tides. Strong offshore winds can move water away from coastlines, exaggerating low tides. Onshore winds can push water onto the shore, making low tides less visible.

High-pressure weather systems can push down sea levels, leading to sunny days with particularly low tides. Meanwhile, low-pressure systems, which lead to cloudy, rainy days, can cause tides that are much higher than predicted.

Quiz

1 What effect do weather systems have on the tides?

(A) Rainy and cloudy days are linked to very low tides on the coastlines.

(B) Windy and sunny days are linked to very high tides on the coastlines.

(C) High pressure can lead to lower tides, and low pressure can lead to higher tides.

(D) Offshore winds can lead to higher tides, and onshore winds can lead to lower tides.

2 The author MAINLY explains the importance of the moon's role in tides by:

(A) explaining how the moon's gravity creates tidal bulges

(B) highlighting how long it takes the moon to orbit Earth

(C) explaining how low tides happen twice in a lunar day

(D) highlighting that the sun and moon both pull at the Earth

3 Examine the graphic in the section graphic in the section "Wait, What?"

Which selection from the article is BEST illustrated by the graphic?

(A) If the moon's gravity is pulling the oceans toward it, how can the ocean also bulge on the side of Earth away from the moon?

(B) Gravity is the major force causing tides, but inertia is playing a part too. Inertia is a resistance against change in direction.

(C) It wants to keep doing whatever it’s doing, whether that’s moving in a straight line or staying still, until another force acts on it.

(D) But Earth is not a perfect sphere, and there are big continents getting in the way of water bulging in the direction of the moon.

4 Use the bottom graphic and information from the article to select the TRUE statement.

(A) Tidal height can change based on factors such as wind and weather patterns.

(B) It takes 12 hours for the ocean water to go from high tide to low tide.

(C) Low tide occurs at the crest of a wave, and high tide occurs at the trough.

(D) Continents get in the way of tide cycles on coastlines around the world.

Answer Key

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