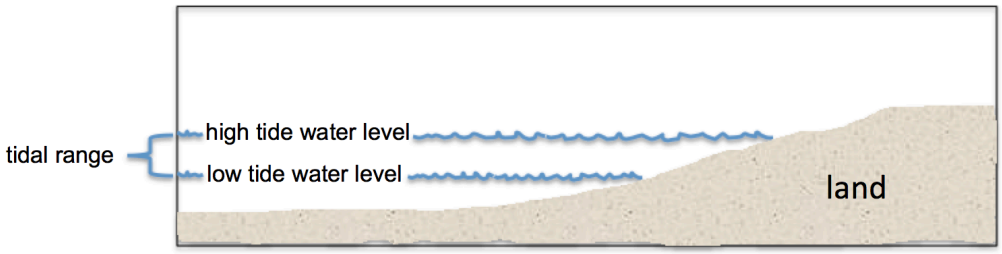
A Tidal Model

Activity

The fundamental force of gravity acts on all matter, including water. Gravitational forces of the Earth-sun-moon system create tidal bulges within large bodies of water on Earth. When Earth turns on its axis, coastlines rotate in and out of tidal bulges causing daily high and low tides. During Spring tides, the high tides are higher than normal and the low tides are lower. During Neap tides, the high tides are not as high as normal and the lower tides are not as low as normal.



Cross section diagram showing water levels at low and high tides.

Procedure

Model Set Up

1.Tape several layers of cardboard together so that a pushpin can be inserted without poking through the back.
2.Use four pushpins and pin the corners of Tidal Model page 1 to the cardboard pieces.
3.Color and cut out the pieces on Tidal Model page 2 as directed.
4.Tape a 20 cm piece of string to the BACK OF THE CONTINENT on the brown SOLID EARTH piece (tape on the white side, not the brown side).
5.Pin the model together as follows:

a. Insert the pin through the North Pole of the blue WATERS OF EARTH so that it becomes the top layer.
b. Push the pin through the North Pole of the brown SOLID EARTH.
c. Pin the (top) blue water layer and (middle) brown solid layer to (bottom) page 1 on the cardboard in the CENTER of the MOON'S ORBITAL PATH.

6.Finish adding the numbers to the orbital path of the Moon pinned to the cardboard. The Moon takes 27.32 days to complete one full revolution around Earth, but this model has been simplified so that only 27 days can be labeled.
7.The perspective of the model is that of someone high above Earth looking down on the North Pole. The one large continental mass is exaggerated so that the effect of high and low tides on its "coastlines" can be easily viewed and is not meant to be an exact replica of Earth's landmasses.

A Tidal Model

Activity, continued

Simulation of High Tide and Low Tide

8.Begin your simulation by positioning the paper Moon on DAY 1 and notice the position of the tidal bulges on the blue oval caused by gravity and inertia.

9.Use teamwork to hold the Moon in place on DAY 1 while another group member gently pulls on the string so that the solid brown Earth begins to rotate on its axis. Remember that the perspective is from high above Earth, looking down on the North Pole. Rotate Earth one full turn on its axis. Observe the water level on the continent.

10. Next, move the Moon to DAY 2 of its orbital path, and again, gently pull on the string so that Earth rotates one full, daily turn on its axis.

11. Continue moving the Moon to additional sequential positions of its orbital path and use the string to cause Earth to rotate on its axis for each corresponding day. Note how the continental mass experiences tides on a daily basis.

12. Use your observations of the working model to answer the following questions in your lab journal.

a. Which parts of the model represent Earth's water pulled into a high tide?
b. What fundamental force acts on large bodies of Earth's water resulting in a tidal bulge?
c. How many times do the continental lands on Earth rotate into a "high tide" each day?
d. How many times do the continental lands on Earth rotate into a "low tide" each day?

Simulation of Spring Tide

13. Re-position the tidal model such that the Moon is in day 1 position and complete the following in your lab journal.

a. What is the resulting formation of the Earth-sun-moon system while in this position?
b. What effect could interactive gravitational forces have on Earth's waters, while in this formation?
c. Diagram this formation of Earth-sun-moon system and title it "Spring Tide Formation."

14. Re-position the tidal model such that the Moon is in day 14 position and answer the following questions in your lab journal.

a. What is the resulting formation of the Earth-sun-moon system while in this position?
b. What effect could interactive gravitational forces have on Earth's waters, while in this formation?
c. Diagram this formation of Earth-sun-moon system and title it "Spring Tide Formation."

A Tidal Model

Activity, continued

Simulation of Neap Tide

15.Re-position the tidal model such that the Moon is in day 7 position and answer the following questions in your lab journal.

a. What is the resulting formation of the Earth-sun-moon system while in this position?
b. What effect could interactive gravitational forces have on Earth's waters, while in this formation?
c. Diagram this formation of Earth-sun-moon system and title it "Neap Tide Formation."

16. Re-position the tidal model such that the moon is in day 21 position and answer the following questions in your lab journal.

a. What is the resulting formation of the Earth-sun-moon system while in this position?
b. What effect could interactive gravitational forces have on Earth's waters, while in this formation?
c. Diagram this formation of Earth-sun-moon system and title it "Neap Tide Formation."

17. Copy the two diagrams below into your lab journal. Decide which should be titled: Cross section showing Spring tidal range and which should be titled: Cross section showing Neap tidal range. Label each diagram.