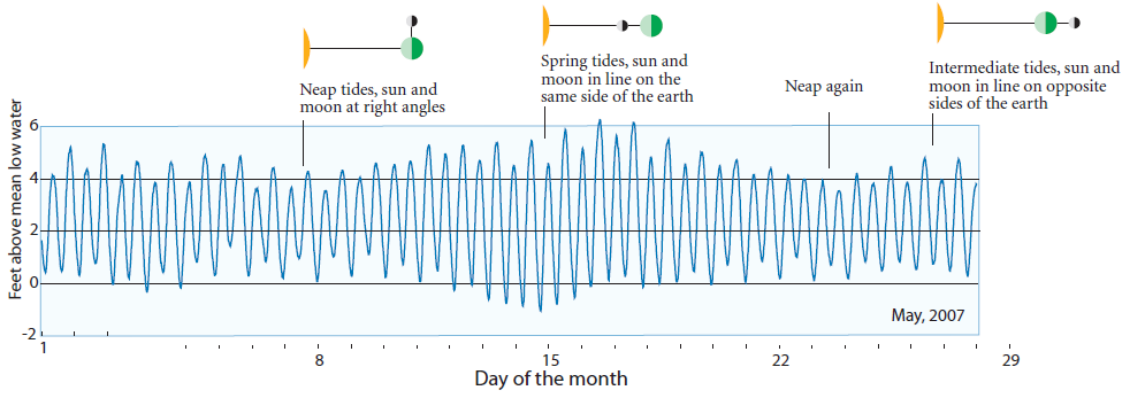
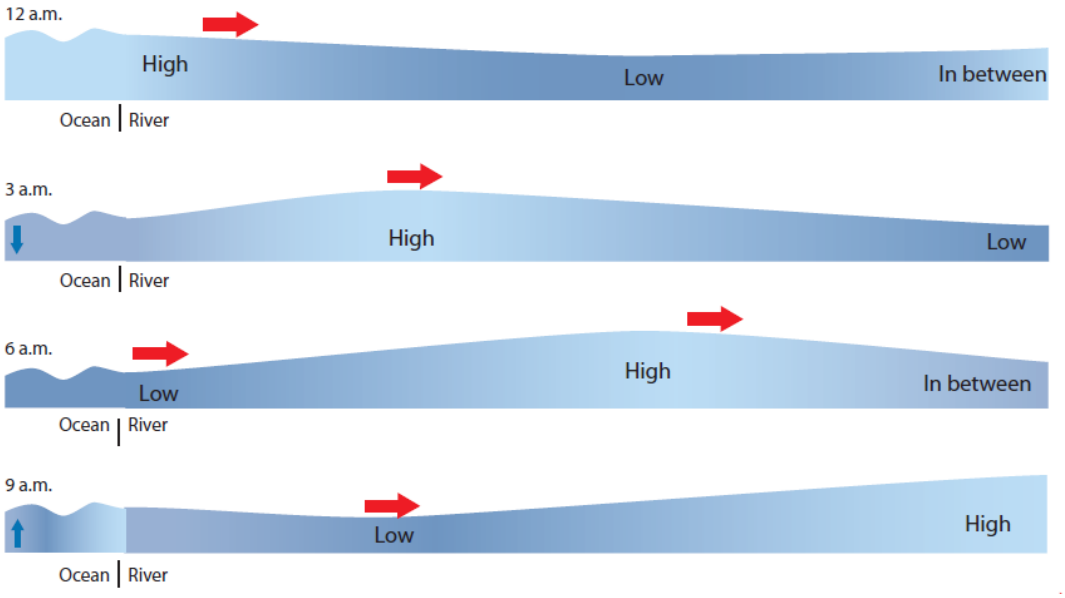
Tides in the Hudson River

If you take some time to watch the Hudson River, you may notice that sometimes the water moves upriver, and sometimes it moves downriver. The Native Americans noticed this change too. Their name for the river, 'Muhheakantuck' means 'water that flows both ways.' Change in the river's direction of flow is not caused by waves created by boats or freshwater coming into the river (though these things can play a role); it is a result of the tides.

Tides are caused by the interaction between gravitational and centrifugal forces. The strongest tides result from the pull of the moon. The gravitational pull of the moon is stronger than that of the sun, since the moon is about 400 times closer to Earth than the sun—yet the sun still plays a role in tidal behavior. When the sun and the moon are in line with one another (i.e. when the moon is full or new), their gravitational pulls add together and cause very strong tides, called *spring tides*. When the moon and sun are at right angles to one another (i.e. during half moons), their pulls partially cancel each other out, and a weaker tide, or *neap tide*, results. These cycles happen every 14 days. Most places on earth have two tides a day, although some places don't have a tide at all, such as the center of the oceans. Due to the topography of the landscape, enclosed bays can have tidal ranges of 20 or 40 feet! The largest daily tide on the Hudson River is over 6 feet, while the smallest is under 3 feet.

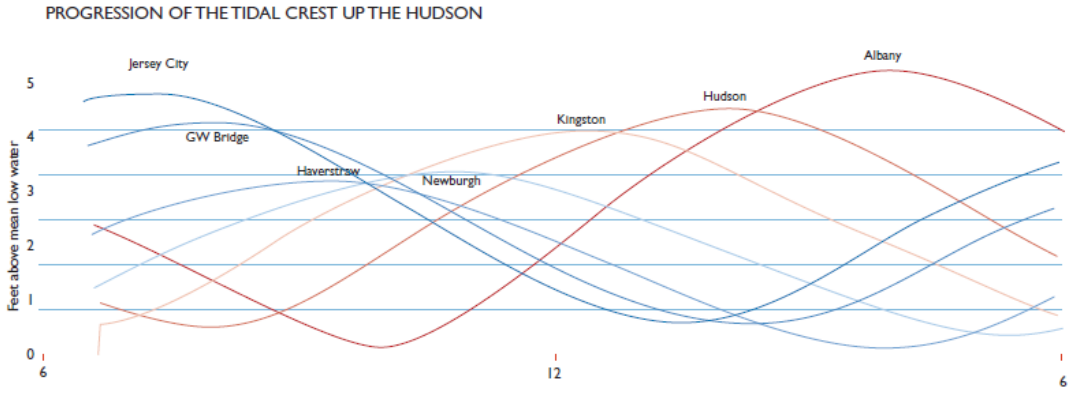


The tides in the Hudson come from the rising and falling of the water at the mouth of the river, not the direct action of the moon. The estuarine portion of the Hudson River ranges from New York City to Troy. Tides travel up the Hudson all the way to the Troy dam, making the water in the Hudson slosh back and forth, much as you would see when you step into a bathtub. The tide would travel further if the dam weren't blocking the water's movement in Troy. The rising and falling in the ocean generates a wave that travels up the river. The red arrow in the diagram on the next page indicates the direction of this wave. The smaller blue arrow at the mouth of the ocean shows the movement of the water at that location.



The river runs north for six hours and then runs south for six hours. The salt front, which is the leading edge of the diluted sea water, is usually south of the Tappan Zee Bridge, but it can reach as far north as Poughkeepsie during droughts. If you tested the water for salt, you would probably not find salinity past Newburgh, NY.

The highest Hudson tides occur at Albany, where the river becomes narrower and the water is forced higher. The graph below shows the range of tide heights in the estuary.



The Hudson is also influenced by the interactions of fresh and salt water, because salt water is heavier than fresh water. Consequently, salt water flows upriver from the ocean along the bottom of the river, while freshwater flows downriver over the top. There is some mixing of the fresh and salt during spring tides or high freshwater flows, but usually there is a layering effect of fresh and salt water called ‘stratification’.

The Hudson River is a complex system. If you want to find out more about tides at a specific location on a certain day and time, you can check the salt front location by visiting the USGS website for the Hudson River Salt Front:
http://ny.water.usgs.gov/projects/dialer_plots/saltfront.html.