Tides: An Ebb and Flow of Life

Introduction:
The ocean waters are a biosystem for a wealth of diverse ocean life as well as the food that nourishes it. Tides are nature’s way of creating currents and an ebb and flow of life in the oceans. Learning to read a tide chart is important because it allows you to predict the level of the ocean at any given time of a month. Activities such as shipping, sailing, scuba diving, and fishing are all affected by the tides. Sea life activities such as obtaining food, shelter and the reproduction and evolution of a species are also part of the cyclic nature of the ocean. For example, tides made it possible for prehistoric species such as the ancestors of water mammals to come onto shore and evolve into land animals and mammals.

Materials:
• Tide tables for one month (from the internet search of tides)

Procedure:
1. Research Question(s):
When are the highest tides in the month? When are the lowest tides in the month? When you look at a moon cycle of the same month, how do the full moon and the quarter moon affect the tides?

2. Literature Review:
Tides are caused by the gravitational pull of the sun and the moon. The sun, although much larger than the moon, exerts a gravitational pull that is less than the moon. In reality the pull is much greater, but because the sun is so much farther away from the Earth, its gravitational pull lessens. The moon then, is the main source of gravitational pull on Earth. Both the sun and the moon pull on the surface of the ocean, which in turn causes predictable changes in the ocean level that occurs approximately twice during a 24 hour period. The highest and lowest tides occur during a full moon and a new moon. The second highest and lowest tides occur during the quarter moons.

The original theory about tides was put forth by Isaac Newton. In his theory, the Earth had two tidal bulges, at the opposite sides of a perfectly uniform Earth that did not take into consideration the water depth, landmasses, and other influences.
Pierre Laplace modified this theory and developed a *dynamic theory*, which showed that there were in fact four tidal bulges due to factors such as lunar and solar gravity, the imperfect sphere of the Earth, the season, the shape of the ocean basin, and the Coriolis effect.

**Figure 1:** diagram showing the relationship between phases of the moon and tidal ranges.

### 3. Hypothesis:

Based on the research question(s) and the literature review construct a hypothesis/predictions below that predicts when the highest and lowest tides should be for North Carolina.
4. **Activity:**

**Learning to use a tide table to predict full moon and quarter moon phases.**

1. On a tidal website that provides monthly tidal information near your geographical area, print the page of data.

2. Create a graph in Excel; on the horizontal axis list the 30 days of a month; on the vertical axis list measurements in feet/meters. Draw the “sea level” line, which represents the average sea level (a marker) regardless of high and low tides. (See example below).

3. For each day and time of the month, plot the height of the tide.

4. Calculate the average tide height and insert this as a horizontal line. With this, you should be able to see the flow of the tides. The highest points are the full and the new moons. The second highest are the quarter moons.

5. On an astronomical data website that provides monthly lunar information near your geographical area, print the page of data. (Mr. Sewell will provide this.)

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**Figure 2:** Sample tidal information broken down into a tidal graph by hours.

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**Observation statements:**

Which day has the highest tide?

Which day has the second highest?

Which day has the lowest tides?
Analysis of Results:
Interpret and analyze your results by answering the following questions.

1. Discuss the evidence you have graphed that measures tides.

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2. How do these tides in turn affect wave action?

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3. Why are waves and tides important? What do they tell us about global warming, melting ice caps, changing climate and natural disasters such as earthquakes, hurricanes, and tsunamis?

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