TEACHER Worksheet: Phases of the Moon and Tides

Subject: Physics & Astronomy **Grades levels:** 6 - 8

Description: Data pattern recognition exercise where students compare the two daily datasets (for one month) to find relationships.

• Uses a spreadsheet dataset provided

This icon is used for teacher suggestions throughout the lesson. Answers to the questions will be inline in **red**.

If you have ever spent a long day at the beach you may have noticed a change in how far the waves would wash up on the sand, over the length of the long day. This phenomenon is due to tidal forces. At certain times of the day, the tide is at a low point and at other times, it is higher and the waves wash further up on the beach. As some of you may know the tides are primarily due to the gravitational force of the moon. Another thing you should know is that it takes 29.5 days for the moon to complete one revolution around the Earth. Let's take a look at some more data to see if we can learn more about the moon and tides.

Open the Excel file called *MoonTides.xls*. At the bottom of the document are two tabs for two slightly different spreadsheets, one labeled *24 Hour* and the other labeled *12 Hour*. Your teacher will tell you which one to click on to open and use. The *24 Hour* sheet might be easier to understand because it does not switch from AM to PM. Both contain moon, sun and tide data for August 2009.

Students may need to view online animation or have done the phases of the moon lab (below) to better answer/understand the following questions.

Whenever you see a ?, partners should write out answers **together**. If you don't know the answer, ask another group for help before moving on.

Whenever you see a, , a partner should do something with the speadsheet file

Sunrise and Moonrise

Look at one row for one day.

1. How many moonrises are there per day? 1
2. How many sunrises per day? 1
3. Why do you think the sunrises and moonrises are the same number? 1 rotation of Earth every 24 hours

Now look at the Moonrise and sunrise columns.

4. How does the time for moonrise change day by day (approx.)? 50 – 60 minutes later each day

5. How does the time for sunrise change day by day (approx.)?
   1 minute later each day (for August, late summer)
6. Why do you think the sunrise time changes day by day? Position of the Earth in its revolution around the sun gradually changes AND the unidirectional tilt of its axis
7. Why do you think the sunrise time changes so little day by day? 365 day revolution
8. Why do you think the moonrise time changes day by day? Position of the Moon in its revolution around the Earth not so gradually changes
9. Why do you think the moonrise time changes more than the sun, day by day?
   Only a 29.5 day revolution cycle
   Hint: Click in the phases animations link at the bottom of the spreadsheet data area and run the third simulation down on the page.
   (http://brahms.phy.vanderbilt.edu/a103/labs/web_moonphases.shtml)

This might be a good time to introduce the reasons for seasons.

Tides

Look one high or low tide column (it doesn't matter which one).

10. How does the time for tide change day by day (approximately)? 50 – 60 minutes later each day
11. What other time change amount is this similar to? Moonrise or set

Now look at one row for one day.

12. How many low tides are there per day? 2
13. How many high tides? 2
14. How far apart are the high tides? Approximately 12 hours
15. The low tides? Approximately 12 hours
16. If the gravitational force of the moon pulls and causes the water to rise for one high tide, when that location's side of the earth is closest to the moon, can you guess why there is also another high tide about 12 hours later at this same location on Earth?
    The earth is pulled and the water on the opposite side of the earth from the moonside is left behind.

Most students would not get this.

Phases of the moon (interactive)

You can have your students do the lab interactive. If you can get the room dark enough and there is pace….or have they play with the interactive web animations.

Lab observations

Working in teams of three:

- One partner will be the Earth and observing (and maybe drawing) phases of the moon she/he observes.
- Another partner will revolve (slowly) around the Earth person, holding up the moon (a ball).
- The last partner will stand stationary about 15 feet away from the other two and shine a flashlight beam on the moon as it revolves around its Earth.
- If you have time switch roles.

Website observations (alternative)

Take a look at the phases animations link at the bottom of the spreadsheet data area and run the third simulation down on the page.
(http://brahms.phy.vanderbilt.edu/a103/labs/web_moonphases.shtml)
And then look at this page for a calendar of phases for August 2009:
http://stardate.org/nightsky/moon/index.php?month=8&year=2009&css=moon.css&Submit=Go

17. How many full moons are there in one lunar month (29.5 Earth days)? 1
18. How many new moons? 1
19. How many quarter moons? 2

Phases and Spring and Neap Tides

The full moon, new moon and quarter phases for August 2009 are also indicated in the Phases column of the spreadsheet. Take a look at the tide height readings in one high tide column. It changes day by day.

20. Can you see any relationships between the highest high tide days and other data in another column the spreadsheet (hint: its not an exact match, but close)? They happen approximately at new and full moons.
21. What about the lowest high tides? They happen approximately at quarter moons.

Relationships between data are called correlations. You may have found some correlations between phase data and highest high tides and lowest high tides. Take a look at the phases animations link at the bottom of the spreadsheet data area and run the third simulation down on the page.
(http://brahms.phy.vanderbilt.edu/a103/labs/web_moonphases.shtml)
Make some observations and try to answer the following questions.

22. Why do you think the highest high tides are around the full and new moon times (hint: there are **3** large objects with gravitational pull at work)? The Earth, moon and sun are all in line and the sun's gravitational force is added to the (stronger) force of the moon's.

23. Why do you think the lowest high tides are around the two quarter moon times (hint: there are **3** large objects with gravitational pull at work)? The moon and its stronger force perpendicular to the Earth and sun line.

Scientists often look at data to explain some observations…or make some observations to try to explain some data. When you looked at the online animations you were observing, to help you explain some data correlations you notice…. but you were also collecting data.

24. What data did you note about the position of the earth, moon and sun at full and new moon time? All in a line
25. What data did you note about the position of the earth, moon and sun at the quarter moon times? Moon is perpendicular to Earth and sun line.

We asked you questions to note what you observed. Much of what we know about the solar system, the Milky Way galaxy and the universe, has been discovered by collecting observed data. The observational data then led to a new understanding.
Extension exercise: Your teacher may ask you to research one famous astronomer and describe one observation they made and what new knowledge it led to.

CA 8th Grade Science Standards
Earth in the Solar System (Earth Sciences)
4. The structure and composition of the universe can be learned from studying stars and galaxies and their evolution. As a basis for understanding this concept:

e. Students know the appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.

The ISTE - National Educational Technology Standards (NETS•S)
1. Creativity and Innovation
Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:

a. apply existing knowledge to generate new ideas, products, or processes.

3. Research and Information Fluency
Students apply digital tools to gather, evaluate, and use information. Students:

d. process data and report results.

6. Technology Operations and Concepts
Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:

a. understand and use technology systems.
b. select and use applications effectively and productively.
c. troubleshoot systems and applications.