# MiSP CYCLIC PHENOMENA — TIDES AND MOON PHASES
# Teacher Guide, L1 – L3

## Introduction

This unit will be implemented a little differently than most of the other MiSP units. Instead of day 1 including an introduction and much of the pertinent content, the first activity will begin after a brief introduction. The discussion of content will come on day 4.

Cyclic phenomena are part of our students' everyday world. They include both natural (night/day, seasons, and moon phases) and human-created (sports seasons, school year, and the seven-day week) phenomena.

This unit focuses on the cycles of the tides and the moon phases and how they relate. Some teachers plan these kinds of activities early in the course because they can serve as an introduction to graphing skills and techniques. Other teachers may incorporate this unit as part of astronomy teaching and learning or even as an oceanography study.

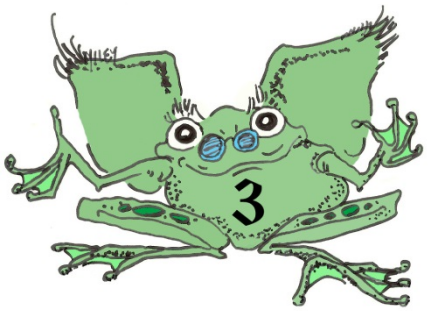
It is recommended that the students have knowledge of the phases of the moon and the reasons for the changing moon phases before this unit is undertaken. Content on tides will be limited to the idea that the moon and, to a lesser extent, the sun cause the tides.

### Standards

**ILST Core Curriculum — Major Understandings:**
Standard 4 Physical Setting 1.1e
**Physical Setting / Earth Science Core Curriculum — Major Understandings:**
Standard 4 Physical Setting 1.1a
Standard 6 Key Idea 5

**Lesson Objectives:** After completing this unit, students will be able to:

- Graph cyclic data for tidal and moon phases
- Predict future low and high tides and particular moon phases
- Correlate the phases of the moon with spring and neap tides
- List and explain the ways that the moon and the sun affect tide heights
- Determine and compare the changing unit rate of change (slope) of selected line segments on the graphed cyclic data (L2)
- Determine and apply the formula for lines to selected segments of the tide and moon phase graphs (L3).

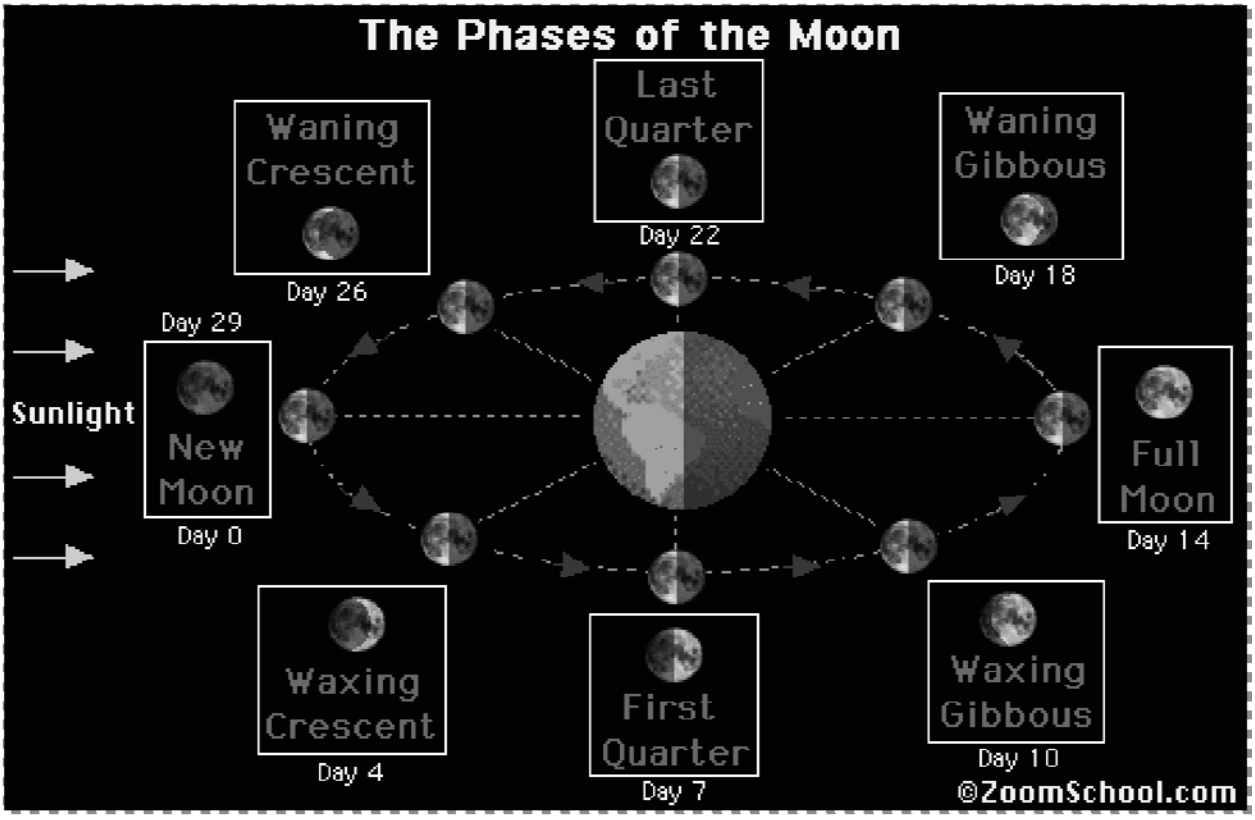


## Days 1 and 2 — Moon Phase Changes over a Two-Month Period — Cyclic Phenomena Worksheet #1

The worksheet/lesson starts with the students brainstorming and listing various cycles that occur. They may be natural or human created. See the introduction for some ideas. (Caution: One or more students may offer the menstrual cycle.) Encourage less obvious (and perhaps less regular or predictable) ones — daily temperature cycles, life cycles for 13- and 17-year locusts, and annual plant life cycles, for example.

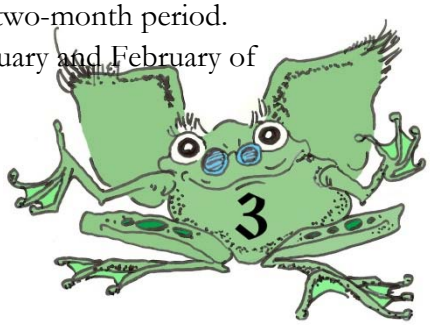
You may also want to play Harry Chapin's song "Circle" ("All my life's a circle…").

The second focus of the cycles brainstorming and discussion will be relationships between any of the natural cycles and what the cause and effect may be. Seasons, for example, are related to the revolution of the Earth around the sun and daily temperature cycles are related to the rotation of the Earth. Students may know that the tides are affected or caused by the moon. Accept all ideas.




http://www.enchantedlearning.com/subjects/astronomy/moon/Phases.shtml

After the cycles discussion, students will graph the phases of the moon over a two-month period. Data is on a chart that should be printed separately. The worksheet assigns January and February of



2010 (also used for the tides). Teachers may choose to have the students work with other two-month time periods. In order to graph the moon phases, the students will use a decimal equivalent to the amount of the moon that is visible (illuminated) on a given day. Therefore, a full moon = 1.00 and a new moon = 0.00. Students may need some help in making the connection.

The United States Naval Observatory website (see http://www.usno.navy.mil/USNO/astronomical-applications/data-services/frac-moon-ill) offers the following helpful explanation:

> *The fraction illuminated is geocentric, that is, it is computed for a fictitious observer located at the center of the Earth. The fraction applies both to*
>
> - *the illuminated area of the Moon's apparent disk divided by the total area of the disk; and*
> - *the illuminated portion of the Moon's apparent angular diameter divided by the total diameter, for the diameter that would intersect the Sun if extended.*
>
> *The Moon's phases are not technically defined in terms of fraction illuminated. However, the phase of the Moon can be identified from the fraction illuminated. To the accuracy given in the table, the fraction illuminated at New Moon is 0.00, at First and Last Quarter it is 0.50, and at Full Moon it is 1.00. First and Last Quarter can be distinguished by noting whether the fraction illuminated is increasing or decreasing. First Quarter occurs when the fraction illuminated is increasing (Moon waxing; in evening sky) and Last Quarter occurs when the fraction illuminated is decreasing (Moon waning; in morning sky).*

The graphing will be started in class during day 1. It is recommended that teachers assign its completion for homework.

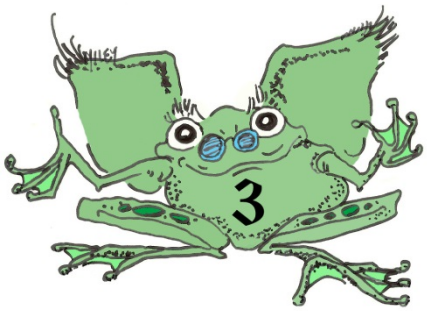
Levels 1, 2, and 3 analysis will occur during day 2.

### Question of the Day:

Are all natural cycles in our lives controlled by the movement of the Earth and the moon?

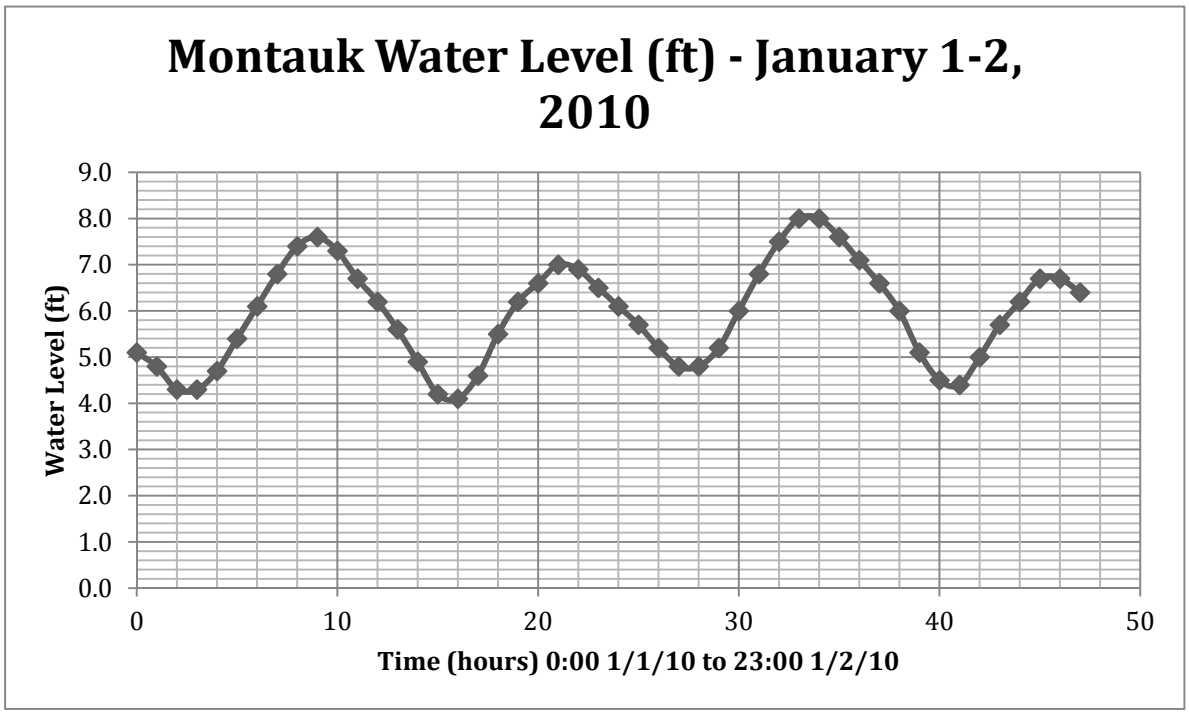
### Days 3 and 4 — Tides and the Moon — Cyclic Phenomena Worksheet #2

Data on tides comes from:
http://tidesandcurrents.noaa.gov/station_retrieve.shtml?type=HistoricTideData&sort=A.STATION_ID&state=NewYork&id1=831

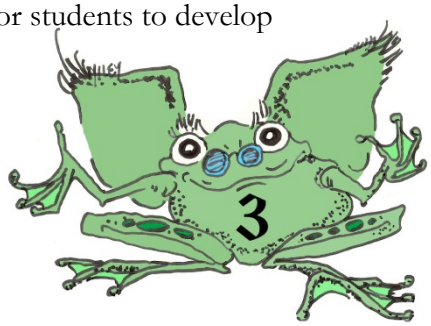


The chart of Montauk water levels for January 1 and 2, 2010, is a separate document for printing. We use station datum for the water level (this avoids negative numbers). Each tide station, according to the National Oceanic and Atmospheric Administration (NOAA), uses "a fixed base elevation to which all water level measurements are referred. The datum is unique to each station and is established at a lower elevation than the water is ever expected to reach. It is referenced to the primary benchmark at the station and is held constant regardless of changes to the water level gauge or tide staff. The datum of tabulation is most often at the zero of the first tide staff installed."

At the intermediate level of instruction, and even at the Regents Earth Science level, our goals for learning about tides should be modest. Tides, the causes of tides, the factors that influence tide heights, and the correlation of tides and the moon's cycles are complicated. The unit work should help students see that tide changes are cyclic but with different highs and lows. The Montauk Point data will produce an easy-to-discern cycle.




The graph of daily water level highs and lows for January and February of 2010 is a separate document for printing. Comparing the daily high and low tides over a two-month period with the lunar cycle over the same period will prompt a discussion about the relationship between the phase of the moon and the maximum and minimum water levels. It will be difficult for students to develop



a clear-cut understanding that new and full moons cause spring tides and quarter moons produce neap tides just from looking at the data from Montauk. Much teacher facilitation will be required.

These useful references, some with simulations, may be used with the students:

http://home.hiwaay.net/~krcool/Astro/moon/moontides/

http://www.mmscrusaders.com/newscirocks/tides/tideanim.htm

http://www.physlink.com/Education/askExperts/ae338.cfm

http://www.pbs.org/wgbh/nova/venice/tides.html

http://www.quoddyloop.com/tides.htm

Teachers will decide how much and when to discuss the other influences on tides beyond the basic sun, Earth, and moon interactions: the shape of the coastline, the configuration of ocean basins, and the water depth.

### Question of the Day:

Why do high tides and low tides not occur at the same time all over the world? Why do they not occur at the same time in the same area? For example, on a recent day, a.m. high tides in the Long Island Sound occurred at Greenport at 4:39, at Nissequogue River at 5:13, and at Huntington Beach at 5:16.

### Day 5

Administer the appropriate level assessment.