LESSON 15 Key Questions

- How many low tides in a 24-hour period in Maine? How many high tides?

Maine has semidiurnal tides; 2 high tides and 2 low tides each day. They are approximately one hour later each succeeding day. So on occasion, the next high or low tide will go into the next day.

(from: www.globalsecurity.org/military/library/policy/army/fm/55-501.chap 7.7-8)

- What is meant by ebb tide? flood tide? slack tide?

Ebb tide occurs as the tidal waters move off or recede from the coast, flood tide occurs when the tide moves onto the coast. Slack tide or slack water occurs when there is no horizontal motion of water and it occurs at each reversal of the current direction from high tide to low tide; from low tide to high tide

- What information can be found on a tidal chart? Where does this information come from? What is LDT and LST, why do we need to know the difference?

Much of the starting information on a tidal chart comes from the reports/data from weather buoys/stations. This information may include but is not limited to the date, range in feet of the tide, mean high water mark, mean low water mark, and time of day, am or pm. As the company or organization printing the chart will use formulas to predict the upcoming tides, it is always an estimate. Many Tide charts will state the time they have been calculated so the tides will be more accurate. For information Daylight savings time – many areas in the world modify their time zones by one hour or more at various times in the year; since 2007 in the United States, most states change from 2:00 LST (local standard time) to 3:00 LDT (local daylight time) on the 2nd Sunday in March; on the first Sunday in November, the time changes from 2:00 LDT to 1:00 LST.

- How is a tidal current chart different from a tidal chart? Why is knowledge of tidal current important?

A tidal current is water moving horizontally in response to tides. At the coast, due to coastal landforms such as reaches, bays, inlets, rivers, and estuaries, currents may move around or over certain areas at a faster speed; a tidal current chart pinpoints the latitude and longitude of an area and gives the current's changing speeds; changes in current can greatly affect navigation and create some dangerous areas

- How are spring tides different from neap tides?

Spring tides are higher than average tides, caused when the sun, moon, and earth are in alignment and the gravitational forces of each work together. Spring tides occur on the new moon and the full moon. Neap tides are smaller than spring tides, occurring on the 1st and 3rd moon quarters when the forces of the sun and moon are perpendicular to each other in relation to the earth. Of note, is that the range of the tidal height does not show great changes day to day where semidiurnal tides (daily tides of 2 highs and 2 lows) occur.

- What is a tidal bore? Where might a tidal bore occur?

A tidal bore is a wave of water of the incoming tide (flood tide) moving in the opposite direction of the normal flow of water in a river or stream. The river is flowing downstream, the bore is moving upstream. It can be a few inches to several feet high depending on the tidal situation at the time. It often occurs when the water from a wider bay moves into an inlet or river, and a bore usually occurs in an area where there is a fairly large tidal range.

- What are semidiurnal tides? Diurnal tides? Mixed tides?

Semidiurnal tides are two highs and two lows each day of similar range in tidal height. One high might be 7 feet with the low at 1 foot; the next high may be 6.8 feet, the next low, 1.3 feet. Diurnal tides are one high and one low each day, with each subsequent high and low showing a slight change in range. On the first day, the high might be 7 feet, the low 1 foot, on the second day the high might be 6.9, and the low might be 1.3 feet. Mixed tides are where successive high water and low-water ranges differ greatly. One tide might be 7 feet at high water and 1 foot at low; the very next tide might be 5 feet at high and 3 feet at low.

Explain what happens to the level of the tides during the phases of a moon cycle from new moon to full moon to new moon. How does the moon's elliptical orbit affect the tides? How does the moon's perigee or nearest point of orbit affect the tides? How does the moon's apogee or farthest point of orbit affect the tides?

The information presented here represents the cycle and ranges as observed in the Northern Hemisphere. The tidal range changes as the moon revolves counterclockwise around the earth. From New Moon (moon not visible) through Waxing Crescent (right side of moon is visible) to 1st Quarter Moon (50% of the right side of moon is visible) to Waxing Gibbous (right side of moon is visible) to Full Moon (100% of the moon fully visible) through Waning Gibbous (left side of moon is visible) to 3rd Quarter Moon (50% of left side of moon is visible) to Waning Crescent (left side of moon visible) to New Moon (0% moon or not visible) in a gradual way. The range of tides is the largest (spring tides) with the highest highs and the lowest lows on the new moon and the full moon. The range of tides is much less during the

neap tides that occur on the 1st quarter moon and the 3rd quarter moon. Starting with the new moon, the tidal range gradually grows smaller during the waxing crescent phases to the 1st quarter moon, the tidal range gradually increases during the waxing gibbous to the full moon, the range decreases during the waning gibbous phases to the 3rd quarter moon, and finally the tidal range increases to the new moon. The tide range changes are caused for the most part by the alignment and position of the moon in relation to the earth and sun. The forces of the moon affect the earth's tide the most, because of its closer proximity to the earth.

Phases are described as viewed from earth in the Northern Hemisphere; phases are New moon (no moon visible or 0%), Waxing crescent (1-49% moon visible on right side), First quarter moon (50% of the moon visible on the right side), Waxing gibbous (51-99% of the moon visible on the right side), Full moon (100% of the moon visible), Waning gibbous (51-99% of the moon visible on the left side), Last/Third quarter moon (50% of the moon visible on the left side), Waning crescent (1-49% of the moon visible on the left side)

- Refer to figure 8r-2 and 8r-3 and the text explanation of the alignment of sun, moon, and earth to produce spring tides
- (Pidwirny, M. (2006)"Ocean Tides". *Fundamentals of Physical Geography, 2nd Edition*.01-10-2012.http://www.physicalgeography.net/fundamentals/8r.html
- Refer to a source that would show pictures to help illustrate moon phases. www.noaa.gov and www.wikipedia.org/wikii/Moon_phases provide some good pictures and illustrations to use with your students. Be sure to check copyright disclaimers before printing material from websites.

The moon has an elliptical orbit,or oval, which causes an affect on tides as well. When the moon is closest to the earth (perigee), the tides are larger than normal. This happens 3 or 4 times a year. If perigee coincides with a storm surge of water, devastation and flooding could occur. At its perigee, the full moon looks much larger than normal. Opposite of perigee is apogee which means when the moon is at its farthest point in orbit from the earth. The moon's affects on the tidal range are less at this time.

- What are weather buoys? What can be learned from them?

The terminology for the data taken from weather buoys will be defined here and in the Master vocabulary list. Many of the terms may be familiar to students who have studied weather. Most of the terms were defined in the glossary found at www.weather.gov/glossary which is a part of NOAA's National Weather Service.

Some of the information weather buoy/station provides are wind direction, wind speed, wind gust, wave height, dominant wave period, average wave period, atmospheric pressure, pressure tendency, air temperature, water temperature, dew point, ice accretion, wind chill (combines wind speed, gust and air pressure). In addition, the location, type of buoy, elevation, and position relative to its surroundings is also stated.

Wind direction is the true direction from which the wind is blowing at a given location (i.e., wind blowing from the north to the south is a north wind). It is normally measured in tens of degrees from 10 degrees clockwise through 360 degrees. North is 360 degrees. A wind direction of 0 degrees is only used when wind is calm.

Wind speed is the rate at which air is moving horizontally past a given point. It may be a 2-minute average speed (reported as wind speed) or an instantaneous speed (reported as a peak wind speed, wind gust, or squall).

Wind gust is a sudden brief increase in the speed of the wind. According to the U.S. weather observing practice, gusts are reported when the peak wind speed reaches at least 16 knots and the variation in wind speed between the peaks and lulls is at least 9 knots. The duration of a gust is usually less than 20 seconds.

Wave height is the distance from wave trough (lowest part of a wave) to wave crest (highest part of a wave).

Dominant wave period - the time, in seconds between consecutive wave crests as they pass a fixed point is the wave period. The dominant wave period is the longest time period between wave crests that occurred during a fixed time period.

Average wave period – The average wave period is the average of the consecutive wave crests in a fixed amount of time.

Atmospheric pressure is the pressure exerted by the earth's atmosphere at any given point, determined by taking the product of the gravitational acceleration at the point and the mass of the unit area column of air above the point

Pressure tendency is the character and amount of atmospheric pressure change during a specified period of time, usually 3-hour period preceding an observation.

Air temperature is a measure of the internal energy that air contains. Temperature is the most measured quantity in the atmosphere.

Water temperature is a measure of the internal energy that water contains at a given time.

Dew point is a measure of atmospheric moisture. It is the temperature to which air must be cooled in order to reach saturation (assuming air pressure and moisture content are constant). A higher dew point indicates more moisture present in the air. It is sometimes referred to as Dew Point Temperature, and sometimes written as one word (Dewpoint).

Ice accretion- the growth of a precipitation particle by the collision of a frozen particle with a supercooled liquid water droplet, which freezes upon impact.

Wind chill (combines wind speed, gust and air pressure)-Reference to the Wind Chill Factor; increased wind speeds accelerate heat loss from exposed skin, and the wind chill is a measure of this effect. No specific rules exist for determining when wind chill becomes dangerous. As a general rule, the threshold for potentially dangerous wind chill conditions is about -20°F.

- What are seamarks? What can be learned from them?

Also called sea mark or navigation mark is a form of aid to navigation and pilotage aid which identifies the approximate position of a maritime channel, hazard, and administrative area to allow boats, ships, and seaplanes to navigate safely. They indicate channels, rocks, shoals, mooring positions, areas of speed limits, traffic separation schemes, submerged shipwrecks, and for many other purposes. Some are only intended to be visible during the day (daymarks) and others may have a combination of lights, reflectors, bells, horns, whistles and radar reflectors to make them usable at night and in conditions of reduced visibility. They are shown on nautical charts. (from Wikipedia at http://en.wikipedia.org/wiki/Sea_mark)

- What are bell buoys? What can be learned from them?

A buoy attached to the seabed with a bell attached to it. The water movement causes the bell to sound. This type of buoy would alert the navigator to his/her surroundings and could be heard rather than need to be seen. Bell buoys had various tones depending on their construction.