Data Analysis Teaching Activity (DATA):
Don't Even Sink About It!

Answer Key

http://www2.vims.edu/bridge/DATA.cfm?Bridge_Location=archive1207.html

Data Activity

I. Investigating ship attributes

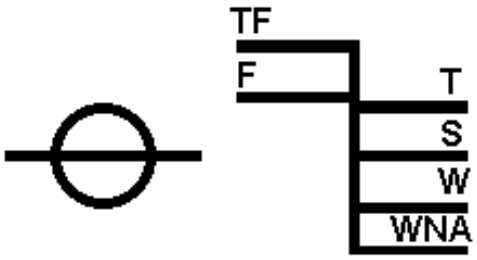
Table 1. Attributes of the M/V *Ocean Hope*.

Attribute	M/V Ocean Hope
Flag/Nationality	*Marshall Islands*
Length (m)	*176.5*
TEU capacity	*1799*
Draft (m)	*10.5*
Deadweight (metric tons)	*26,366*
Gross Tonnage (metric tons)	*18,037*
Net Tonnage (metric tons)	*10,484*
Max Speed (knots)	*18*

II. Understanding the Plimsoll Mark

A. Using the information learned above, answer the following questions regarding the Plimsoll mark.

1. Fill in the blanks below.



TF = __*Tropical Freshwater*_____
F = ___*Freshwater*_____
T = ___*Tropical Saltwater*_____
S = ___*Summer Saltwater*_____
W = ___*Winter Saltwater*_____
WNA = __*Winter North Atlantic*___

2. In terms of density, why would a ship float lower in "T" water than in "W" water?
   Warmer water, so density is less

3. The ship in Figure 2 is being loaded in Philadelphia, PA (fresh water) for its trip to Miami, FL, has it been overloaded with cargo? How do you know?
   No, not yet. The water line has not yet reached the "F" line (but is close)

B. Use Figures 3a-c to answer the following questions.

4. The ship in Figure 3a just left port (tropical freshwater) after being loaded with cargo, why will the captain's boss be upset with him? *Because the ship is not yet filled to capacity*

   A. Why is this a potentially dangerous situation?
      Cargo could shift in heavy seas (if not properly secured) and create an unbalanced ship, which could potentially be easier to capsize, etc.

5. What is wrong with the ship in Figure 3b? Can you offer some suggestions as to why this happened?
   -It was overloaded
   -It was loaded above the "T" line and sailed into freshwater OR Loaded to "TF" in saltwater and sailed into freshwater (tropical)
6. What is the problem in Figure 3c? How can it be fixed?
   -Bow is overloaded – Move cargo aft (towards the stern/back)

III. Hindcasting (evaluating archived data) accessibility of the York River, VA by the *M/V Ocean Hope*

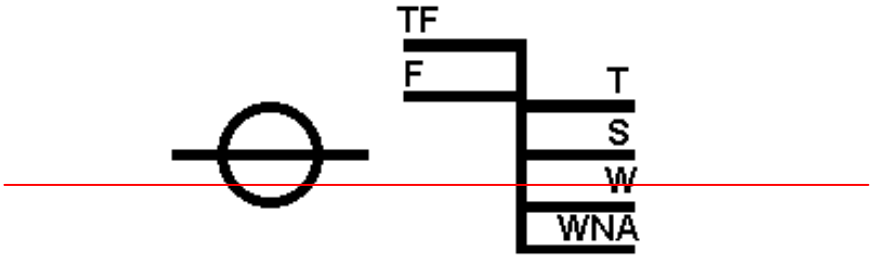
A. Refer to your Table 1 of vessel attributes and view Figure 4, a graph of mean water depth data from the week of October 29 to November 5, 2007.

From the figure:

1. What is the range in water depth? *~9.9-10.93m*
2. Why does the water depth increase and decrease daily? *Tides (semi-diurnal)*
3. On what day was the water the deepest? *November 3rd*
4. On what day was the water the shallowest? *October 31st and November 1st*
5. Provided the M/V Ocean Hope was loaded properly, could it enter the York River whenever it wanted during the week shown? *NO*
   a. If not, is there any point during the week that the ship could enter the river and not scrape the bottom (water depth ≥10.6m)? If so, when?
      Yes – Oct 29, 30, Nov 2, 3, 4

b. For each date, about how much clearance would there be between the hull of the ship and the sea floor?
Oct 29th-0.35m; 30th-0.09 and 0.21m; Nov 2nd- 0.12 and 0.27m; 3rd-0.42 and 0.29m; and 4th-0.32 and 0.15m

6. The average temperature and salinity of the York River during this time period were 13.8°C and 22.8 ppt, respectively. If the M/V Ocean Hope was loaded properly in its departure port and had enough water to sail in the York, where would the water line be on its Plimsoll mark?



B. Now view Figure 5, a graph of the mean water depth data from the year beginning on November 5, 2006.

7. What is the range in water depth? *9.35-11.75m*
8. During what month was the water the deepest? *November 2006*
9. During what month was the water the shallowest? *February 2007*
10. During what season is the M/V Ocean Hope most likely to encounter water deep enough to enter the York River? *Fall*

a. Formulate a hypothesis to explain this observation.
More rainfall; Lunar proximity (Need more data to determine why, e.g. USGS stream flow)

b. The U.S. Coast guard stipulates that in order for a ship to enter a channel or port, there must be 2-3 feet of water between the bottom of ship's hull and the sea floor. With this regulation in mind, is the water at the mouth of the York River ever deep enough for the M/V Ocean Hope to legally enter?
Note: You must convert the depth from meters to feet (1 foot = 0.305 meters)
Yes, Nov 06; Once in late April and again in late June 07

IV. Nowcasting (evaluating real-time data) accessibility of the York River, VA by the M/V Ocean Hope

A. Click on the red balloon at the mouth of the York River, Station YRK000.00B.
The data that you see is the most recent data report from this buoy.

1. When were these data reported? **Real time data, answer will vary*
2. When these data were reported, what was the mean water depth? **Real time data, answer will vary*
3. Is the river deep enough for the M/V Ocean Hope to enter the York River? **Real time data, answer will vary*
4. Is the river deep enough for the M/V Ocean Hope to legally enter in the eyes of the U.S. Coast Guard? **Real time data, answer will vary*

B. Using the VECOS buoy Station YRK005.67B, which is further up the York River at Gloucester Point, VA, answer the following:

1. What is the current salinity and water temperature at this location? **Real time data, answer will vary*

2. If the M/V Ocean Hope was loaded properly in its departure port and had enough water to sail in the York, where would the water line be on its Plimsoll mark? **Real time data, answer will vary*

3. Given the current temperature and salinity measurements at Gloucester Point, calculate the density using the density calculator found at http://www.es.flinders.edu.au/~mattom/Utilities/density.html (*in situ* pressure is 101kPa).

   Temperature (C): ___*Real time data, answer will vary___
   Salinity (ppt): _____*Real time data, answer will vary___

   The note at the bottom of the density calculator states, "Add 1000 to the result to obtain density in kg m^{-3}." These are the same units the Rutgers glider density plots are reported in the Extension activity. How does the current density in the York compare to the density of the waters off New Jersey and the Delmarva Peninsula?

   Current York River Density (kg m^{-3}): ___*Real time data, answer will vary_____
   Comparison to the Rutgers plots: *Rutgers density plots (from Figures 1 and 2) show a density range of 1021 to 1025.5 km m^{-3}. Density in the York River is much lower. Explanation: Water offshore over the continental shelf will be saltier (data indicate between 31 and 35ppt) and cooler (data indicate between 6 and 24°C).*

Application Questions

1. The salinity at the mouth of the York River is typically between 15-22 ppt. Will the Ocean Hope float higher or lower in the water if there was a big rain storm which dropped the salinity to 9-13 ppt? (Draw a Plimsoll mark if it will help!)
   Ship will float lower because the water is less dense due to the drop in salinity.

2. If the above rain storm was part of a strong cold front that dropped the water temperature by 5° C, what effect would this have on how high or low the ship floated? (Draw a Plimsoll mark if it will help!)
   The ship may float at the original depth or higher because the water could be more dense due to the drop in temperature. We would need the actual salinity and temperature data in order to determine the draft.

A. View Extension Figures 1 and 2; salinity, temperature, density plots, and transect maps from two COOL glider missions and fill in the data table below.
Note: On the transect maps, the start point is indicated by the green dot, and the stop point is the red dot.

	A	B	C	D	E	F
Figure	**General location of the transect**	**Direction of Transect (compass direction)**	**Depth of deepest data point (m)**	**Highest salinity recorded (ppt)**	**Lowest temperature recorded (?C)**	**Are these extreme data points (D and E) found in the same area of the figure?**
1	*NJ Shelf*	*ESE*	*90*	*34*	*7*	*No*
2	*VA Shelf*	*SW*	*48*	*34.3*	*11*	*No*

1. Considering the entire water column, do Figures 1-2 appear normal (i.e. colder water is below warmer water and higher salinity water is below lower salinity water)? Why or why not? Be specific.
   a. Figure 1 – *Yes, all denser water is below less dense water*

   b. Figure 2 – *No, higher salinity water is above lower salinity water*

2. Consider your answers in Column F. If the highest salinity recordings were in the same area of the figure as the lowest temperature recordings, what would you expect the density plot to look like?
   That area of the figure would indicate extremely high density data

3. Explain how would it be possible for saltier water to exist overtop less salty water?
   The saltier water would have to be warmer OR less salty water would have to be cooler (same thing)