Physical Characteristics of the Ocean

Pressure is the amount of force exerted on a given area.

**To Do:**

1. Put the glove on one hand.
2. Point your fingers straight down and insert your bagged hand into the water. **Do not insert your** **hand so deep that the glove fills with water**.
3. As your hand goes deeper, describe what you see and feel in your data.

**Question/Analysis**

1. What is different between the water at the top of the bucket and the water at the bottom of the bucket?
2. Look at the definition of pressure. How does the difference in the water at the top of the bucket and the bottom of the bucket change in regard to pressure?
3. What would you predict would happen to the glove if the bucket of water were 8 ft. deep?
4. Based on your observations, where would pressure be the highest- at the top of the bay or at the bottom of the bay?

Salinity is a measure of the amount of dissolved salts in seawater, and is measured in parts per thousand. Density is the amount of matter in a given space or mass per unit volume (D=M/V), and is measured in cm3 or ml. If something is less dense than the liquid it is floating in, it will float.

# To Do:

1. Obtain a plastic cup. Pour in 100ml of cold water.
2. Place a small carrot (approx. 2”) in to the first cup. What happens?
3. Add salt, two grams at a time, to the cup of water with the carrot in it. Stir the solution and record your observations.
4. Continue adding salt until the carrot floats. How many grams did you need to add to have the carrot float?

**Question/Analysis**

1. Use the formula for density, D=m/v where m= mass of the salt and v= the amount of water, to figure out the density of the water to get the carrot to float.
2. If you were swimming, which would be easier to float in, fresh water (Density of 1 g/ml) or salt water?

**To Do:**

1. Take your glass beaker and fill it to 150 ml with warm water.
2. Add a red ice cube to your water.
3. Draw what happens as the ice cube melts.

**Question/Analysis**

1. In which direction are the red color streams heading?
2. What happens after all the ice is melted?
3. Based on observations, is cold water more or less dense than warm water?

# To Do:

1. Take a 300 ml glass beaker and pour in 125 ml cold salt water (green). Take the temperature of your water.
2. Obtain some cold fresh water and take its temperature. Try to have both the salt and fresh water at the same temperature.
3. Tip your beaker of salt water and slowly pour in an equal amount of cold, fresh water (clear) Draw and label what you see.
4. Leave the beaker and see what happens to the fresh and salt water over time. Record your observations.

**Question/Analysis**

1. Which is less dense; cold, fresh water or cold, salt water?
2. When rivers run into the ocean, where would you expect the water from the river to be, on top of the ocean water or at the bottom?
3. What would happen to the river water over time?

**Background** Ocean water is a combination of freshwater and a variety of dissolved salts and other trace elements. While there are local differences in salinity and temperature of ocean water, the composition of seawater is fairly uniform around the globe. Typically, seawater has a salinity of 3.5% and a density of between 1.026 and 1.028 g/ml.

Ocean currents are the large-scale water movements that occur at the surface and in the depths of the oceans. Surface currents are driven primarily by global wind patterns while subsurface currents are driven by ocean water density differences. Subsurface currents may also be caused by differences in the salinity or by temperature variations.

In Monterey Bay, wind patterns alter in March-June and cause an important change in the bay.Winds change direction, causing the warmer top water of the bay to be blown offshore. When this happens, the **cold, nutrient rich water from the bottom of the bay rises to the top, displacing the warmer water, and is called upwelling.**  This important seasonal event, allows food/minerals that have been lying on the bottom of the ocean, to become available to the plankton (both phytoplankton-plant drifters and zooplankton=animal drifters) at the top of the bay. Our kelp forests especially depend on these phenomena.

Visible light represents a narrow band of electromagnetic radiation that appears white when all colors are present. The colors of the spectrum are red, orange, yellow, green, blue, indigo and violet (ROY G BIV) Each color of the visible spectrum has specific wavelength ranges. An object appears a certain color when all other wavelengths are absorbed except the color being seen, which is reflected. For instance, plants appear green, as they contain chlorophyll, which absorbs red and blue light and reflects green light. Objects that appear white reflect all wavelengths, while objects that appear black absorb all wavelengths.

As light travels through water, it is absorbed. The longer the wavelength of light, the less energy the photons contain, and the quicker they are absorbed. This is why the loss of red light occurs first, as red wavelengths are long but contain less energy so they are absorbed first. Blue wavelengths contain the most energy in the visible light spectrum and are absorbed last.

The colors at the middle of the visible spectrum (yellow, green and blue) penetrate seawater to the greatest depth, while colors of longer (violet) and shorter (red and orange) wavelengths are absorbed and scattered more rapidly. Once a spectrum of light is no longer visible, objects that reflect that color will appear black. So a red object at a depth where red light is no longer visible will appear black unless an artificial light source is used to illuminate it. This property of light influences the coloration patterns and distribution of marine organisms. Organisms that live in ocean depths with red coloration effectively “disappear” in the inky darkness, because no red wavelengths are present.

In addition, some deep sea organisms are transparent animals that allows them to blend into their surroundings. Many of these transparent animals also utilize the color red for camouflage, especially around digestive organs. These red guts hide bioluminescent (produce their own light) prey, effectively camouflaging the predator from becoming prey itself!

The amount of light at a certain depth also depends on the angle of the sun and the turbidity (amount of particles in the water) of the water (Church 1994). If the water is clear, light can penetrate further; however, if there are a lot of floating particles in the water, or the water is very churned up, the light can either be absorbed or reflected more readily or scattering can occur. The scattering of light will shorten the distance of visible objects that can be seen underwater and blur the details. If the sun is directly overhead, light will penetrate deeper in the water, than if it is lower on the horizon as more light is reflected at the surface.

**Visible Light**

**To Do:**

1. Obtain a pair of glasses and a red, blue and green filter.
2. Look at the red, blue and green paper with each of the different filters. Record the “real” color of the paper and the color of the paper as seen through each of the filters.

**Question/Analysis**

1. Describe how the filters “changed” what you saw.

# To Do: (If done as a class- ignore the timer position and have the whole group sort at the same time)

1. Obtain a blue backdrop (felt or paper) and M & M’s.
2. Make a data table listing each of the colors of the M & M’s and the # of film layers (1-4)
3. Obtain 4 blue film layers for each eye on your glasses.
4. Have one person act as timer, and two people act as “sorters”. Mix up the M & M’s on the blue backdrop.
5. The sorters will put one blue filter in their glasses. In 30 seconds, try to sort all the M & M’s by color. Record how many you were able to sort into groups correctly.
6. Repeat using 2 films, 3 films, and 4 films. Record your data after each trial.
7. Make sure that the timer also has a chance to do this activity.
8. Record the actual number of each color of M & M that you have in total.
9. Figure out the percentage of correct sorting for each film trial by dividing the total number of correctly sorted M & M’s by the total number of M & M’s.

**Questions/Analysis**

1. Make a graph showing correctly sorted vs. non-correctly sorted M & M’s. What type of graph is the best used and why?
2. Look at your data and determine if there is a pattern you notice regarding # of correctly sorted candies and the number of films used. What is the pattern?
3. In the ocean, how many films used would represent the top of the water? The bottom of the water column?
4. Which colors became more difficult to see as you added the blue films?
5. Read the background and write a hypothesis as to why certain colors “disappear” with increased depth.