

## Oceanography Merit Badge

**Objective:** Introduce students to the study of oceanography by focusing on the properties of sea water, plankton, waves, and the geography of the sea floor. We will customize our Save the Bay program to focus on Narragansett Bay's properties.

**Audiences:** Focused on reaching requirements of the Boy Scouts Oceanography Merit Badge. Boy Scouts range from grades 6-12. 2 hours.

**Goals:** The Boy Scouts will be able to...

1. Identify the four types of oceanography.
2. Define the chemical properties of water and learn how they are tested.
3. Identify the unique properties of water.
4. Identify biologically important properties of seawater by a plankton tow.
5. Understand the different topography of the bay and ocean.

**Materials:**

- **Introduction- STB chart**, photos of 4 types of oceanography,
- **Station One-** oxygen & hydrogen atoms, pennies, dropper, YSI, refractometer, thermometer, hydrometer
- **Station Two-** pictures of plankton, benthos, nekton; plankton tow
- **Station Three-** weather instruments

**Activities:**

**Introduction**

1. **Save the Bay Introduction (10 min):**
  - a. Who? Save the Bay What? Educate, Protect, and Restore  
Why? To ensure that the people within the Narragansett Bay watershed are informed about the need for a healthy Narragansett Bay and land surrounding it. Be sure that they are provided with ways they can help to Save the Bay.
2. **Oceanography Introduction (10 min):** What is Oceanography? (Not one single definition- divided between four branches.)
  - a. Show large posters of oceanography braches and have the scouts discuss the properties of each.
  - b. Discuss why it is important to study the ocean and Narragansett Bay.
    - i. Reference Section has additional information about branches and importance.
3. **Discuss how program will work.** Scouts will divide into 3 groups and rotate to stations every 30 minutes.

**Stations**

**Divide into 3 Stations. Rotate every 30 minutes. (90 minutes)**

1. **Water Chemistry**

- a. **Why is water special?**
  - i. **Have the large models of oxygen and hydrogen atoms.**

1. Ask the scouts what the smallest parts that all living things are made up of. Continue to say that Atoms combine to make molecules.
2. Show them how oxygen and hydrogen combine to make water.

**ii. Explain the properties that make water special.**

1. Cohesion- the intermolecular attraction between like-molecules- WATER STICKS TO WATER-
  - a. Use a penny to see how many drops of water can fit on the top of a penny.
2. Adhesion- tendency of dissimilar particles and/or surfaces to cling to one another –WATER STICKS TO OTHER MOLECULES-
3. Water expands when it freezes. –Think about an ice tray... what happens to the water.

**iii. Is ocean water just water molecules?**

1. Explain that there are other gases and nutrients in sea water.
2. Ask them if they can think of any elements, gases, or nutrients that may be in the Bay.
3. Conservative elements: sodium (Na), chloride (Cl-), sulfate (SO<sub>4</sub>), magnesium (Mg<sup>2+</sup>), calcium (Ca), and potassium (K)

**b. Water chemistry.** Now that we know it is unique, how do we test water's properties?

**i. Collect a water sample.**

1. Use a YSI after first property test, if available, to show that there are different ways to test water properties.

**ii. Test for salinity by using a refractometer.**

1. Ask them how evaporation or precipitation would change the salinity of water.

**iii. Test for Temperature by using a thermometer.**

**iv. Test for density by using a hydrometer.**

**2. Plankton**

**a. Discuss some of the biologically important properties of seawater.**

- i. Show the large pictures and have the scouts come up with a definition for the group.
  1. Benthos
  2. Nekton
  3. Plankton

**b. Plankton Collection on Alletta Morris**

- i. Staff sets up nets
- ii. Staff discusses plankton- zooplankton, phytoplankton
- iii. Staff uses microscope to find and focus on plankton. Now, the scouts can see the plankton on the TV.

iv. Scouts will use identification materials to identify plankton.

### **3. Water and Weather**

This station will involve three main observations that uncover the principle causes of weather and climate.

#### **a. Wind Direction and intensity**

- i. Using a compass, anemometer, and the power of individual observations we will determine the dominant wind direction and speed.
  1. This will involve learning compass directions and doing speed calculations using nautical miles. If we are in or around the water we will observe the effects of the wind on wave action.
- ii. During these observations the scouts should discuss the effect of large bodies of water on the weather and climate.
  1. Account for Storm Surge, tsunami, tidal wave, and tidal bore.

#### **b. Cloud Cover**

- i. Using a cloud chart and active observation we will determine the type of clouds and the %cover in the visible sky.
- ii. From this we can extrapolate the effects of clouds on the productivity of phytoplankton and the dissolved oxygen in the bay.
- iii. We can also discuss what various cloud types mean with regards to changes in weather and precipitation.

#### **c. Tides**

- i. Using observations and a tide table we will determine the state of the tide at the time of the observations and relate this to the currents that will affect the bay at that time.
- ii. This discussion can center on the gravitational relationship between the earth, moon, and sun that creates the tides.
- iii. Discuss specifics of ocean waves- Sea, swell, surf, and breakers.

### **Conclusion (10 minutes)**

1. Bring the groups together and talk about the different branches of oceanography and how they can expand their knowledge with more research.
2. Save The Bay Closing with emphasis on Importance of Oceanography.

## Reference Materials

### The four branches of oceanography:

- **Biological oceanography (marine biology)**
  - study of plants, animals, and microbes of the oceans and their ecological interaction with the ocean
- **Chemical oceanography (marine chemistry)**
  - Study of the chemistry of the ocean and its chemical interaction with the atmosphere
- **Geological oceanography (marine geology)**
  - Study of the geology of the ocean floor including plate tectonics
- **Physical oceanography (marine physics)**
  - Study of ocean's physical attributes including salinity, mixing, waves, tides)
- **Describe at least five reasons why it is important for people to learn about the oceans**
  - Food source
  - New supplies of fresh water by use of desalination plants
  - Source of the world's salt supply
  - Many different chemicals and minerals are found in the oceans
  - Oil and gas trapped beneath the seafloor
  - Solar, Wind, and water energy
  - Study the ocean to learn affects on weather and climate patterns

## Water Properties

**Salinity**- measurement of the amount of salts dissolved in a water sample. It is measured in parts per thousand (ppt)

- **What are some sources of salinity in Narragansett Bay?**
  - **Tides.** The level of the tide affects the amount of salt water mixing with freshwater. If the tide is incoming- the salinity will be higher- if the tide is outgoing the water is rushing out of the bay and the salinity will be lower.
  - **Precipitation.** Rain/Snow/Sleet all affect the amount of fresh water levels in the Bay. If there has been a lot of rain within the past couple of days the salinity will be affected.
  - **Depth of water column.** The depth of water that you take your salinity measurements.
  - **Runoff.** Runoff is water running off of the land and into the nearest river, lake, stream or Bay. Runoff is a contributor to salts in the Bay due to chemicals put on the land that contain salts.
- **How to measure salinity in Narragansett Bay.**

The instrument we use to measure salinity in the water is called a YSI meter. It is used to measure DO, temperature, and salinity. Basically it is a small

computer with a probe, attached to the bottom of the cord, which does all the work for you.

- **Questions to think about after you are done with all of your measurements.**
  - Did the salinity measurements increase or decrease as you went further into the water column? Why?
  - What was the tide doing when you did your test? How did it affect your results?
  - What part of the Bay were you in when you took your measurements? How did that affect your results?

**Temperature-** Temperature is the measure of the average movement of atoms and molecules within the water system.

- **What are some of the sources that affect temperature in Narragansett Bay?**
  - **Sun.** The presence or absence of the sun can increase or decrease the temperature of the water.
  - **Plants.** The increased production of plants due to too many nutrients in the water can increase the temperature of the water because their overabundance slows down the natural movement of water and the plants act as a sun trap.
  - **Stormwater Runoff.** Run-off brings chemicals from the land into the bay. This can increase the temperature of the water directly or cause a chemical reaction that produces heat as a byproduct.
  - **Nuclear Power Plant.** Thermal pollution from power plant cooling stations can raise nearby water temperatures.
- Measured by mercury thermometer and YSI.

**Density-** measure of the amount of material held in a certain space.

- Measured by a hydrometer
- Determined by the interactions between salinity, temperature, and pressure
- **There are many different salts, gases, and nutrients in the seawater.**
  - Conservative elements: sodium (Na), chloride (Cl<sup>-</sup>), sulfate (SO<sub>4</sub>), magnesium (Mg<sup>2+</sup>), calcium (Ca), and potassium (K)

**To use the YSI meter:**

- The cord is marked in meters (silver duct tape) and half meters ( green tape)
- You will be taking readings at different depths
  - surface (planktonic zone)
  - middle (nektonic zone)
  - the bottom (benthic zone)
- Someone will tell you the depth of water the boat is in for you to get the depth you should be measuring at **OR** you can look on Captain Eric's fish finder/ GPS to find out the depth for yourself.
- Salinity is measured in parts per thousand (ppt)

## Plankton

- Plankton are microscopic plants and animals in the water that form the basis of the food chain in Narragansett Bay.
  - There are two types of plankton: phytoplankton (plant) and zooplankton (animal).
- **How does plankton get into the water?**
  - **Reproduction.** Plankton gets in the water from plants and animals reproducing. Plankton are basically plant and animal babies.
  - **Sunlight.** The sun's rays play a very important part in the production of phytoplankton.
- **How do we collect plankton from the water?**
  - We collect plankton using a plankton tow net. The net has very fine mesh (small holes) that only allow water to escape. The plankton get caught in the net.

## Important Definitions during Weather

- **Storm surge-** offshore rise of water associated with a low pressure weather system
- **Tsunami-** Series of water waves caused by the displacement of a large volume of body of water
- **Tidal bore-** large movement of water formed by the funneling of the incoming tide into a river or narrow bay
- **Sea-** refers to a large expanse of saline water connected with an ocean and commonly used as a synonym for ocean
- **Swell-** formation of long wavelength surface waves
- **Surf-** where water breaks at surface
- **Breakers-** form when the trough (or wave) hits the bottom and rises toward the shore, the crest falls, then the wave breaks up