



An Unsettled Matter [ME]

Grades: 3-5

Time: 45 minutes to 1 hour

Goals: To understand how erosion caused by sea level rise contributes to the sedimentation of coastal waterways.

Objectives:

Students will be able to: define and explain turbidity and what causes it; explore how turbidity and sedimentation affects photosynthesis; and discuss how sea level rise can increase erosion and turbidity.

Materials:

Circular or rectangular deep plastic bins

Soil

Sand

Pitchers and spray bottles of spring water

Plastic circular discs (pre-cut to 4" diameters with holes in the center)

Rope or string (cut for each group)

Lead weights

Permanent markers

Rulers

Procedures:

1. Pre-Activity (introduction): Introduce sedimentation to the class in terms of what may cause it (erosion, run-off, and boat propellers stirring up bottom sediment). Ask them to elaborate on how these suspended solids might affect marine life in the estuary or along the coast in terms of the food web and photosynthesis.
2. Activity: Students will work in groups of 3-4 to first build a coastal bay area and then to create a secchi disk in order to measure turbidity. Have them use the bins to represent the bay and add first soil to one end of the bin, and then sand in front of it to about 1/4 from the top of the bin. Explain that this would be typical uplands and wetlands sediment found along the coastline. They will slowly add water to the empty end of the bin, allowing some of the sand to settle to the bottom, and only to the edge of the sand area.

Using the string or rope, have each group tie off a weight to one end, then pull it through the center hole in the plastic disc. Using the rulers, measure out two inches at a time and mark the rope with the permanent marker. They have now created a secchi disc. Have them carefully place the disc into the water and lower it down until the weight hits the bottom. Using their fingers to mark the surface of the water, pull the disc out and count how many marks they can read. This is their secchi disc calibration and will be the "normal" turbidity of the water.



Have each group measure the amount of turbidity after one rainfall and a second rainfall – spray the water onto the soil and sand until the sediment falls into the water. Take the secchi disc and again place it gently into the water and lower it until they can no longer see the white of the plastic. Using their fingers again to mark the surface, count the number of inches that are marked. After both rainfalls, explain that sea level is rising, and have the groups add more water from the pitcher until it is covering half of the sandy area. Measure the turbidity. Make it rain once more and measure the turbidity. Sea level has risen again, covering the entire sandy area. Measure the turbidity. One last rainfall and have the students measure the turbidity.

3. Post-Activity (review): Discuss the results of their experiment and how turbidity changed as sediment was added. Explore how added sea level altered the turbidity and how this would change not only the coastline, by increasing erosion and sedimentation, but also change the food web within the ecosystem.

Key Words:

Turbidity

Sedimentation

Runoff

Precipitation

Secchi disc

Sea level rise

Point-source pollution

Non-point source pollution

Watershed

Background Information:

Adapted from National Estuarine Research Reserve and Ontario Ministry of Natural Resources

When water is turbid, it is not clear even before it has been stirred up by currents, tides, animal movement, or boat wakes. This translucent or opaque water is caused by particles that are suspended in the water column. These particles can be both organic, in the form of animal waste or planktonic organisms, and inorganic, as in rocks, minerals, soil, silt, etc. Turbidity then, is the measurement used to determine the quality of water that contains these suspended particulates. Scientists can use a secchi disc to determine the turbidity of a sample of water.

Sometimes, turbid water can be exacerbated by inorganic particulates from soil erosion and sedimentation, creating a poorer water quality than under normal conditions. Soil erosion can be caused by natural process such as rain, wind, tides, and currents, or by anthropogenic, or man-made, processes such as boat wakes or dredged channels. When soil is deposited by runoff into estuaries, rivers, lakes, or streams, it is called sedimentation. Both erosion and sedimentation processes are accelerated due to over-development and poorly regulated land use, such as for deforestation and agriculture, which contribute non-point source pollution to the ecosystem.



These processes can have varying impacts on estuarine ecosystems, from plankton down to larger species such as fish and birds. When the quality of the water is reduced, the system can radically change, both in physical and chemical properties. As soils and other particulates are added to the system, the properties of water change, from its taste to odor to temperature. Particulates naturally absorb heat, so by raising the surface temperature of the water, it also decreases the amount of dissolved oxygen needed to survive.

Having turbid waters also greatly reduces light penetration down into the water column. With the reduction of light, phytoplankton and submerged vegetation cannot photosynthesize at their normal rates. Some plants also show damage to their leaves and slower growth rates in these waters. With their decreased growth rates, species that rely on them for food and shelter exert more energy, and more oxygen, finding the best vegetation.

Particulates also can damage animal systems and organs. For invertebrates, they can clog filter feeding organs and digestive tracts. This directly affects their feeding activity, growth rates, and mortality rates. Fish species tend to be more susceptible to reduced visibility to find their prey, clogged gill rakers, and lower dissolved oxygen as the surface temperatures increase.

With the right regulations of development and runoff from sedimentation, estuaries will be less turbid in the future. Because of the proximity to a valuable resource such as an estuary or the ocean, over-development and land-use practices need to be carefully maintained. Some natural erosion will occur but the process does not need to be exacerbated by poor management.

