LESSON PLAN: HARBOR ESTUARY IN A PAN

Overview:

Students create a model to demonstrate the impact human activities can have on water-based habitats including the Harbor **Estuary** and the Atlantic Ocean. Model may also be used to demonstrate additional relevant concepts including functions of a wetland or marsh, non-point source pollution and the **watershed** concept.

Objectives:

Following completion of this lesson students, will be able to:

- Recognize the connection between natural and developed areas and the impact human activities in developed areas can have on natural areas.
- Understand what is meant by the term "watershed."
- See the value of adopting environmentally friendly habits in everyday life.
- Appreciate the contribution estuaries and wetlands make to human needs and everyday lives.

Grade Level: 5^{th} – 12^{th}

Materials: To make model you will need: one paint roller pan, non-hardening modeling clay to fill 1/3 the roller pan, sponges to fit across the width of the tray (for optional extension), house and animal templates included in this lesson plan prepared from heavy paper (laminated if possible), toy cars, buildings, model trees and shrubs, grasses.

To complete the demonstration you will need:

Watering can
Clear containers
Two-cup measuring cup with spout (for optional extension)
Green food coloring
Soy sauce or oil
Bits of paper
Ground coffee
Chocolate sprinkles

Background:

A **watershed** is an area of land that drains into a **river system**. Any water that enters a watershed, usually as precipitation, travels from higher **elevations** to lower ones. As the water moves downward, it enters creeks, streams and rivers. The channeling and pooling of water is determined by the shape or topography of the land. Water continues to move downward, and rivers may join with lakes or other rivers as they head toward the ocean. For those of us living near the Harbor Estuary, our own local watershed more than likely drains into one of several rivers (Hudson, Raritan, East, Navesink, etc.) that make up the Harbor Estuary.

Procedure:

1. Briefly review what students know about estuaries and discuss with them how different types of pollution can enter and move about the area.
2. Prepare in advance or have students build a model of a typical estuarine area in a paint tray.
3. Build the model in the pan by adding a 1/2" thick layer of modeling clay to the shallow top third of the pan. Build in creeks, rivers, a storm drain, a road, building, trees and plants into the clay terrain. The low end or well of the tray represents the estuary itself connected to the ocean.
4. One by one sprinkle "pollutants" onto the landmass. Add a few drops of food coloring to symbolize chemical fertilizers. Overuse of fertilizers adds excess nutrients to the water which can result in algal blooms or too much algal growth. Algal blooms are generally followed by a decline in **dissolved oxygen**. This is known as **eutrophication**. Bits of paper symbolize litter, chocolate sprinkles symbolize pet waste (which adds harmful bacteria including fecal coliform to water), oil or soy sauce symbolize motor oil dumped or leaked from vehicles and coffee grounds symbolize loose sediment or topsoil which, when washed or eroded into water results in diminished water clarity **(turbidity)** and excess sedimentation and lessening of water depth (in the Harbor Estuary for instance, maintaining water depth is critical for navigation).
5. Ask students to make predictions about what will happen when it "rains" on the model. Record predictions then have students gently "rain" water onto the land mass area. Students should then observe where their "pollutants" went and compare their predictions to what actually happened.
6. Pour dirty water into a clear container so students can see just how polluted the rainwater became.
7. Add drama by asking—"would you want to swim in this?!"

Closure:

Reinforce student awareness that estuaries are subject to the impacts of people, including themselves. Sewage, litter, chemical pollutants and storm drain runoff can enter the water from sources near and far. All of this pollution is eventually carried to the ocean.

Vocabulary:

Dissolved oxygen: the oxygen available in water for aquatic organisms
Effluents: waste material discharged into the environment.
Elevation: in reference to geographic locations, is its height above a fixed reference point, often the mean sea level.
Estuary: waterbodies where salt water and fresh water meet and mix.
Eutrophication: the process by which a body of water becomes rich in dissolved nutrients either naturally or by pollution.
River system: all of the streams and channels draining a river basin.
Turbidity: thickness or opaqueness of water caused by stirring up or introducting sediment.
Watershed:

Extension:

To demonstrate salt marsh function within an estuarine environment, add a marsh to your model by placing damp sponges or a strip of carpeting across the open edge of the clay terrain. Repeat the demonstration. Before rain event, record student predictions about how this demonstration will be different than the first round without the sponges (salt marsh). To demonstrate the ability of a salt marsh to absorb excess water and prevent flooding, use the same, pre-measured amount of water for your "rainstorm" each time (with and without sponges in place). Record predictions and re-measure

"polluted" water after each round. Observe changes (less water, less pollution with salt marsh in place).

Background Information for Extension:

Plants from the salt marsh help handle pollutants in several ways. Marshes can take up and filter the pollutants while others settle into the soil strata and are chemically reduced over time. More are processed by bacterial action. When salt marshes are filled or lost, pollutants they could have rendered harmless remain in the water and are free to move all over the water system and into the ocean. In addition to its great buffer zone and filtering capacity, the salt marsh is capable of absorbing and holding large quantities of water for use by wildlife in times of drought.

Salt marshes are effective storm buffers and provide flood control because they dissipate wave energy and soak up tidal surges. Salt marsh plants are also a defensive against the erosive power of tides because they have deep roots that hold soil in place. If allowed to erode freely, this soil can decrease water clarity (affecting the ability of aquatic plants to photosynthesize) and decrease water depth. This decrease in water depth is particularly critical to the shipping industry which requires certain water depths to navigate ships into and out of the Harbor.

Sea Grant
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