Island STYLE

Galveston Bay Watershed: An Eco-Art Workshop by Artist Boat

SUBJECT:

Science

GRADE LEVEL:

6th

TIMEFRAME:

45 minutes

MATERIALS:

- Introduction to Galveston Bay
  - Map of Galveston Bay
  - Colored dry erase markers (3 colors)
- Demonstrating Brackish Water
  - Cups
  - Food coloring
  - Salt
- Threats to Galveston Bay
  - NPS kit
  - Watershed poster
- Importance of the Estuary
  - Spartina grass root system model
- Reference Materials
  - Guidebooks
  - Reference sheets
  - Posters
  - Figurines
  - Feathers
  - Shells

ACTIVITY SUMMARY:

Students will be learning about environmental awareness, observational skills, and biological knowledge, which will result in informed decision making, responsible behavior, and constructive actions concerning wildlife and the environment.

LEARNING OBJECTIVES:

- Differentiate salt/fresh/brackish water characteristics
- Understand threats to Galveston Bay due to pollutants
- Identification of Galveston watershed contributing bodies of water

ALIGNMENT:

TEKS

Science -

6.1 (B) – Practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials
6.2 (A) – Plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology
6.3 (B) – Use models to represent aspects of the natural world
6.3 (C) – Identify advantages and limitations of models such as size, scale, properties, and materials
6.3 (D) – Relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content
6.7 (A) – Research and debate the advantages and disadvantages of using coal, oil, natural gas, nuclear power, biomass, wind, hydropower, geothermal, and solar resources

Ocean Literacy Principals

1 Earth has one big ocean with many features
2 The ocean and life in the ocean shape the features of Earth
4 The ocean makes Earth habitable
5 The ocean supports a great diversity of life and ecosystems
6 The ocean and humans are inextricably interconnected

VOCABULARY:

- **Biomagnification** – the concentration of toxins in an organism as a result of its ingesting other plants or animals in which the toxins are more widely disbursed
- **Brackish water** – A mixture of salt and fresh water
- **Erosion** – the wearing away of the Earth's surface by wind, water, or energy
- **Estuary** – a partially enclosed, coastal body of water where freshwater from rivers and streams mixes with salt water from the ocean
- **Hypoxia** – a state in which oxygen is not available in sufficient amounts at the tissue level to maintain adequate homeostasis
- **Non-point source pollution** – pollution that comes from many different sources, including storm water runoff and agricultural runoff; origins cannot easily be identified or regulated
- **Pelagic** – relating to the open sea
- **Point Source Pollution** – pollution that comes from definite sources, such as wastewater treatment plants, industry, or large chemical or oil spills
- **Salinity** – dissolved salt content of a body of water; measured in ppt (parts per thousand)
- **Wetland** – the place where water meets land and the land is saturated with water at some point during the year

BACKGROUND INFORMATION:

What are the 4 functions of the wetlands?

1. Flood prevention
2. Water filtration
3. Erosion prevention
4. Nursery habitat

The Galveston Bay Watershed

Galveston Bay is an estuary located in between Houston and Galveston along the upper Texas coast. The Galveston Bay connects the Trinity River and the San Jacinto River to the Gulf of Mexico. Galveston Bay is the seventh largest estuary in the United States, covering 600 square miles and is the second most productive fisheries in the United States.

Brackish Water

Due to the combining of the Trinity River, the San Jacinto River, and the Gulf of Mexico, the Galveston Bay consists of brackish water. The salinity, or amount of salt in the water, of an estuary can greatly influence the species present. Due to our growing need of fresh water, many estuaries are threatened to become too salty for many of these estuarine dependent animals to complete their lifecycles. Salinity is measured in parts per thousand (ppt). The average salinity of ocean water is 35 ppt, while brackish water is somewhere between 5 and 30 ppt. Freshwater stays below 5 ppt.

The Value of Estuaries

Estuaries are important because 90% of all fish, shrimp, and crabs need estuaries to complete their lifecycle. Besides providing food and income for many local people, pelagic, or ocean dwelling animals like tuna, red snapper, and marine mammals, depend on the food created from the estuary. Without the large amount of food created in the estuary, our oceans would be devoid of life.

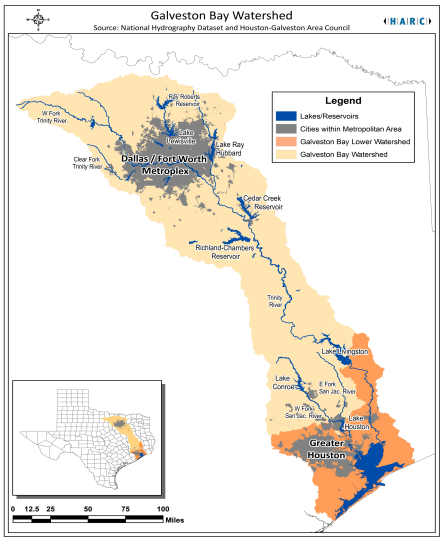
Estuaries are also home to a certain type of habitat called wetlands. A wetland is any area that has vegetation adapted to living in the water, soils that chemically and physically show they have been inundated with water, and water present for at least part of the year.

In Galveston Bay, there is a certain type of wetland called salt marsh wetlands. These wetlands are characterized by plants, such as cordgrass (Spartina spp.) that live in the shallow waters along the shoreline. These areas are important for many reasons, the main one being providing a nursery ground for many species of juvenile fish, shrimp, and crabs. Many juvenile animals feed off the grasses or off of epiphytes (plants and animals growing on the grasses) and use the grasses to hide from predators. Wetlands also act like a sponge, retaining water during times of rain. Houston was once covered in wetlands, but now because of the vast amount of concrete present, floods very easily. In addition, the roots and rhizomes (underground horizontal stems) of the salt marsh grasses help to prevent erosion by holding the soil in place. Finally, salt marsh grasses are highly effective at removing toxins from the water and holding sediments down, therefore helping to filter the water in Galveston Bay and keep the water less turbid from suspended solids.

Threats to Galveston Bay

There are many threats to Galveston Bay, including pollution, habitat loss, and subsidence. Pollution is a major threat to the bay due to the large size of the Galveston Bay watershed. A watershed is any surface area from which runoff resulting from rainfall is collected and drained through a common point. The Galveston Bay watershed covers 33,000 square miles, stretching from Dallas to Houston. The watershed for Galveston Bay is so large partly due to the Trinity River that originates in the Dallas/Fort Worth area. All of the potentially polluted runoff from the Trinity and San Jacinto rivers eventually drain into the Galveston Bay.

There are two types of pollution entering Galveston Bay: point source pollution and non-point source pollution. Point source pollution comes from definite sources, such as wastewater treatment plants, industry, or large chemical or oil spills. Non-point source pollution comes from many different sources, including storm water runoff and agricultural runoff. Non-point source pollution is a much bigger threat to water quality than point-source pollution because its origins cannot easily be identified or regulated.



MISCONCEPTIONS:

Some think that the Galveston water is dirty. While there are pollutants present in every body of water, the Galveston water appears dirty due to the turbidity, or lack of clarity. Turbidity is a result of suspended solids in the water. These solids are comprised of both organic and inorganic materials such as plankton and microscopic organisms, or clay and silt. Several different factors affect the turbidity of Galveston's water.

The sediment on the ocean floor off of Galveston Island is very fine silt that is easily suspended by wind and waves. The ocean floor also has a shallow gradient as you move away from Galveston, so the waves churn up the sediment as they head toward shore.

Sediment is also added into our coastal ecosystem. The Trinity River and other rivers and bayous in our watershed deposit sediment as they flow into Galveston Bay. Currents in the Gulf of Mexico also carry some of the sediment discharge from the Mississippi River to Galveston. Sediment loads can be greater in the spring when larger rain events and snowmelts increase river flow. Also, land-use changes have added to the sediment present in rivers as sediment becomes destabilized and more susceptible to erosion.

The presence of microscopic organisms in the water also adds to the water turbidity. These organisms in turn respond to nutrient loads in the water. Zooplankton eat phytoplankton and are food for fish and other marine life.

PREPARATIONS:

1. Acquire three cups
    a. Fill one cup with water and add one drop of red food coloring and one teaspoon of table salt
    b. Fill the second cup with water and add one drop of blue food coloring
    c. Leave the third cup empty
2. Set-up the non-point source (NPS) kit
    a. Put figurines on the model (i.e. barn, factory, home, animals, people)
    b. Fill spray bottle with water
    c. Acquire 4 small bottles and fill each with water
        i. Add one drop of red food coloring and mix
        ii. Add one drop of blue food coloring and mix
        iii. Add one drop of yellow food coloring and mix
        iv. Add one drop of green food coloring and mix

INTRODUCTION:

Show a picture of Galveston Island and ask leading questions to find out what students know and want to learn about the area. Show artifacts such as shells, skulls or feathers and ask leading questions to find out what students know and want to learn. Also take note of misconceptions that are voiced and be sure to address those later in the presentation.

GUIDED PRACTICE:

Introduction to Galveston Bay

Using a map, show the location of Galveston Bay. Explain that because Houston touches the shores of Galveston Bay, it is considered a coastal city. Ask for four volunteers. Give each volunteer a card with either the Gulf of Mexico, Galveston Bay, Trinity River, or estuary on it. Give sticky tack to the students that have the Galveston Bay, Trinity River, or the Gulf of Mexico cards and ask them to locate these areas on the map. Ask the volunteer with the estuary card to define an estuary. Students may also point out different parts of Galveston Bay such as the ship channel, West Bay, East Bay, or Trinity Bay. You should put a flag on the map near your school.

Demonstrating Brackish Water

Ask for three volunteers. Give the cup with blue water (no table salt) to the first volunteer. Give the cup with red water and table salt to the second volunteer, while the third volunteer gets the empty cup. Ask the person with the blue water to taste the water and describe what it tastes like. Next, ask them where they think this water could have come from (Trinity or San Jacinto River). Ask the second volunteer to do the same and describe where the water could have come from (Gulf of Mexico). Next, have the students each pour half of their cup of water into the empty cup. The student does not have to taste the water this time, but ask them to tell you what kind of water this is (brackish). Reiterate that this experiment is similar to the mixing of fresh and salt water in Galveston Bay.

Write the three different ranges of salinity with their corresponding area on the board for the students to see. Explain that different areas of the bay have different salinities based on their proximity to the Gulf of Mexico or fresh water sources, such as the Trinity River. Using the map, show them that Trinity Bay, for example, would have a lower salinity than west Galveston Bay. Ask them if they think the salinity would be greater in the winter or the summer (summer would be higher because the water gets hot, evaporates, and leaves salt behind. Furthermore, because of the reduced amount of rainfall in the summertime, the rivers are not contributing as much fresh water to the estuary).

Importance of the Estuary

Show the Spartina grass and root system. Explain that the roots of estuary plants are about 3x as long as the part of the plant that is above the soil and water. If you can see a 1 foot tall plant, the roots would be about 3 feet long. Demonstrate that the roots do not grow vertically down, but rather horizontally, creating a net-like affect that holds the soil in place. Pass "roots" out to multiple students that are spread out throughout the classroom. Stand in the middle of the roots holding the plant and ask students to gently pull on the "roots". Have certain students pull harder to demonstrate what it would be like when wind or water pressure increases. One-by-one, have students begin letting go of their "root" to demonstrate that even as plants are being uprooted, the plant is kept in place by these roots that go in all different directions.

Threats to Galveston Bay

To demonstrate non-point source pollution, use the non-point source pollution (NPS) kit. Set the kit out and explain that this farm represents one of the many farms between Houston and Dallas located near the Trinity River. Give the farmer a name and a specified crop. Hold up the bottles of "pollutants" and explain what each one is, how they benefit the farmer, and how each can harm the environment.

1. **Fertilizer** - used to make plants grow; can have a negative effect when it gets into waterways because it can lead to algal blooms. Oftentimes, algal blooms cloud the water, which can damage coral reefs or sea grass beds. Algal blooms can also cause hypoxia (low oxygen levels) because the bacteria that reproduce uncontrollably during the algal bloom use up all the oxygen during respiration.

2. **Herbicide** – a type of pesticide that kills unwanted weeds; can negatively affect animals when it enters waterways. Both farmers and homeowners use herbicides to kill unwanted plants, either for aesthetic lawn purposes or to prepare a more stable growing environment for the preferred crop.

3. **Insecticide** – a type of pesticide that kills organisms that eat desirable plants; can also be used on the exterior of homes or businesses to keep insects outside. DDT was used in the US during the 1950's that almost led to the extinction of the brown pelican, the bald eagle, and a few other bird species. DDT traveled up the food chain in a process called biomagnification. In biomagnification, the concentrations of a chemical become greater as you travel up the food chain. DDT was first sprayed on farms to repel and kill bugs that would eat the plants. This DDT then became present in bugs and microscopic animals and plants in the water called plankton. Fish that eat the plankton or bugs would then accumulate the DDT in their bodies, and larger carnivorous fish would eat those fish and accumulate even more in their bodies. Finally, an apex predator, such as a bald eagle or a brown pelican, who eat hundreds of fish per year, eat the large fish with DDT in them and become ill. Because DDT is not metabolized as quickly as other nutrients, it accumulates at every tropic level, causing the concentrations to become larger at each level. DDT caused brown pelican eggs to become very thin and brittle, so that when the bird sat on the egg to incubate them, they would break. Obviously, there were not many baby brown pelicans being born until after DDT was banned, in the 1960's. A woman named Rachel Carson helped to publicize the negative effects of DDT in a

book titled Silent Spring, named because of the possibility of having a silent spring when all the animals were extinct from heavy chemical use. It took many years after DDT was banned for both the brown pelican and the bald eagle to be placed off the endangered species list.

4. **Oil** – motor oil that runs off from roads or that is illegally dumped into waterways/storm drains poses a great threat to wildlife; since oil floats on the surface of the water, it is easy for animals to consume it or have it cover their body which can lead to them dying due to poisoning or drowning

Once the chemicals have been explained, have a volunteer come up one at a time to spray the chemicals on the farm. Ask the students to remember what each chemical does for the farmer and to the environment. Have the final volunteer spray water on the farm and explain that this represents a big rainstorm. Open the lid on the NPS kit and show the students the polluted water that has traveled down the river and entered Galveston Bay.

INDEPENDENT/GROUP PRACTICE:

Ask students to sketch their version of the Houston/Galveston area. Have students add 10 places, things, or landmarks to their map. These things could include their home, school, church, sport facility, or favorite restaurants, as well as the Gulf of Mexico, Galveston Bay, Pelican Island or Bolivar Peninsula. Allow students to share with the class their maps and what all they chose to include.

ASSESSMENT OF LEARNING:

Ask students to reflect on the pollutants that are threats to Galveston Bay. Have them determine 3 ways that pollutants could be minimized or prevented.

CLOSING:

As you teach lessons linked to our Galveston Bay watershed and the Gulf of Mexico you can use the “I Wonder” board as a closure assignment.

For example, after teaching about the Galveston Bay Watershed, you might ask what else the students want to learn about pollutants. Students may ask about additional animals that were affected by DDT, or specific microorganisms in Galveston Bay or other bodies of water and the water chemistry present. All of their questions (even the ones asked multiple times) would go to the “I Wonder” board. If a question was answered in the lesson, it still goes on the board.

Students may even have questions days later that could be added. The goal is to have a place for all questions about Galveston Bay and Gulf of Mexico to be housed.

EXTENSION:

Learning more about the Galveston Bay watershed and the Gulf of Mexico can be done through the NOAA VWET (Virtual Watershed Education & Training) online program and websites such as NOAA and Galveston Bay Foundation.

NOTES: