Island STYLE

Blue Carbon Science Workshop

SUBJECT:

Science

GRADE LEVEL:

6th

TIMEFRAME:

45 minutes

MATERIALS:

- Sea Level Rise Activity
  - Expo marker
  - 2 plastic tubs
  - Ice
- Ocean Acidification Activity
  - Clear cup
  - Eggs
  - Vinegar
- Carbon Storage Visual
  - 4 plastic bins
  - 50 green ping pong balls
  - 50 black ping pong balls

ACTIVITY SUMMARY:

- Students will learn about coastal ecosystems, oceans, and climate by analyzing graphs and interpreting data.

LEARNING OBJECTIVES:

- Differentiate sea/land ice characteristics
- Understand threats to Galveston Island due to carbon emissions
- Identification of Galveston watershed contributing bodies of water
- Recognize the value of carbon sequestering

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
6.5.(C) – Differentiate between elements and compounds on the most basic level
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
6 The ocean and humans are inextricably interconnected

VOCABULARY:

- **Anthropogenic** – Originating in human activity
- **Estuary** – A partially enclosed, coastal body of water where freshwater from rivers and streams mixes with salt water from the ocean
- **Brackish Water** – A mixture of salt and fresh water
- **Blue Carbon** – Carbon that is stored in the soils of wetlands
- **Carbon Dioxide** – A gas produced by burning fossil fuels; absorbed by plants during photosynthesis
- **Carbon Sink** – Description of wetlands as they sequester carbon and store it in their soil
- **Calcium Carbonate** – Ions are extracted from seawater and used as the building blocks that create the outer shell of some marine species
- **Climate Change** – Significant change in the Earth's climate over a long period of time; includes major changes in temperature, precipitation, or wind patterns that will last for extended periods of time
- **Ocean Acidification** – The changing chemistry of the ocean that is causing it to become more acidic
- **Subsidence** – Sinking of land due to changes in use of surface and ground water
- **Sea Level Rise** – Change in the level of the sea that occurs because of thermal expansion, melting of land ice, and subsidence
- **Thermal Expansion** – Rise in level of water due to movement and expansion of water molecules

BACKGROUND INFORMATION:

What are the 5 functions of the wetlands?

1. Flood prevention
2. Water filtration
3. Erosion prevention
4. Nursery habitat
5. Blue carbon sink

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. Due to the combining of these two major rivers and the Gulf of Mexico, the Galveston Bay consists of brackish water.

Climate Change

Climate change is significant change in the Earth's climate over a long period of time that can include major changes in temperature, precipitation, or wind patterns that lasts for decades or longer. Climate change is partially attributed to anthropogenic causes, meaning that humans are causing climate change. The burning of oil, coal, and natural gas puts excess carbon dioxide into our atmosphere, acting like a heat trapping blanket around the globe. Climate change leads to changes such as sea level rise and ocean acidification.

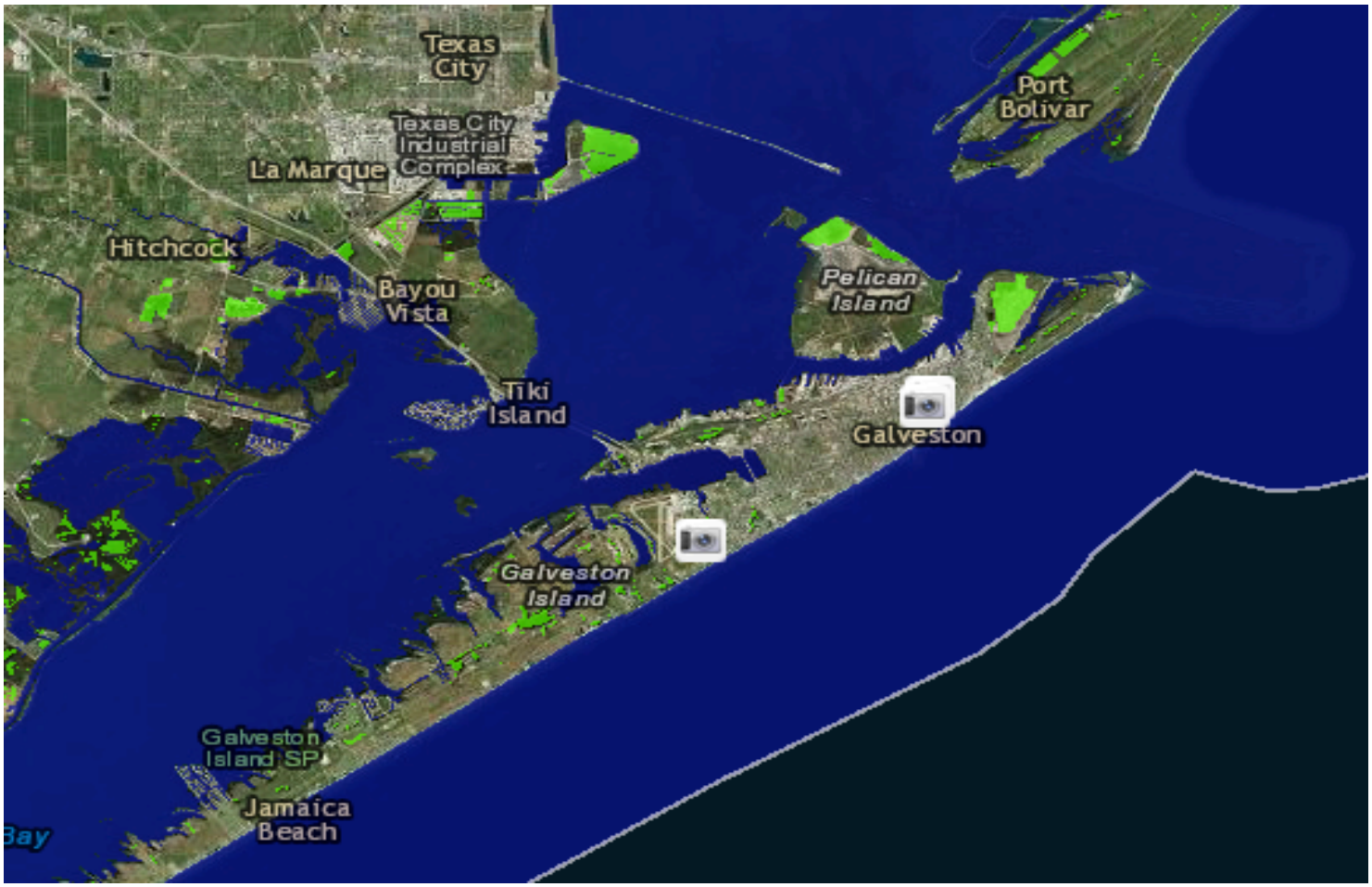
Sea Level Rise

Sea level is rising on a global scale, but the Galveston area is experiencing sea level rise 3x the national average. These changes due to sea level rise do not happen overnight, therefore there isn't a physical danger to humans. The map below depicts the current sea level in the Galveston region.

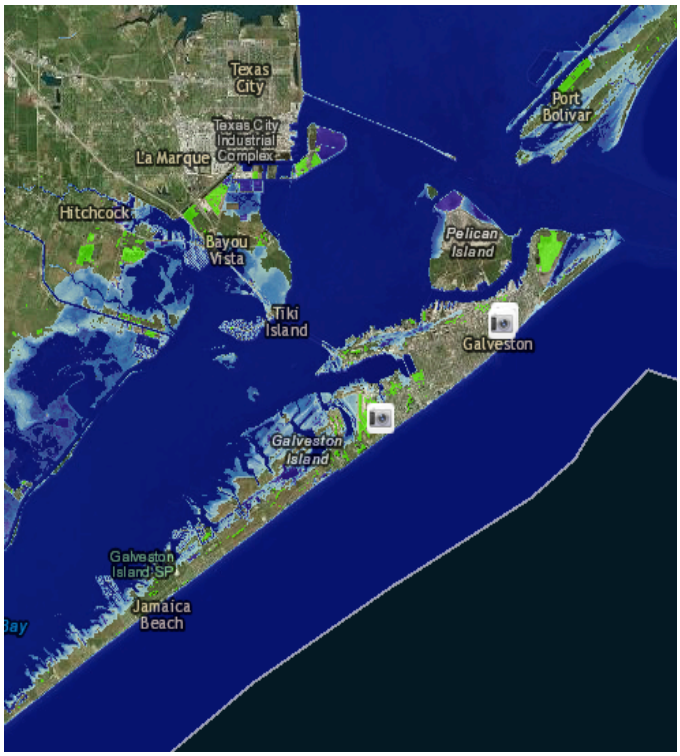
Sea level rise can occur due to thermal expansion, land-based ice melting, or land water storage. Thermal expansion is the tendency of matter to change in shape, volume, and area in response to a change in temperature. This occurs as water warms and it expands. Thermal expansion can be represented by visualizing a pot of boiling water. As water boils, bubbles form and at times, the water may begin to overflow out of the pot. The same occurs in the Earth's bodies of water. Land water storage alterations occur when changes in runoff and storage of surface and groundwater affect sea levels. This is when the land begins sinking due to oversaturation of the soil, but it appears as though the water level is increasing. Venice, Italy is one example of a "sinking city". The groundwater was pumped out from beneath the city for years, causing the slow shift of increasing sea levels. Land-based ice melting occurs as giant blocks of ice melt and rapidly adds thousands of gallons of water to the volume of the ocean. Both Greenland and Antarctica are great examples of this.

Currently, the city of Galveston is only about 7 feet above sea level on average. Scientists have predicted that in the next 50 years the sea level in this region will increase by 3 feet. If this occurs, low-lying areas of the island and areas surrounding Galveston Bay will slowly become submerged. Identifiable landmarks affected by this increase may include East Beach, the Artist Boat headquarters, and Tiki Island. Predictions have also been made that in the next 100 years, sea level will increase by 6 feet. The majority of regional landmarks, including the Bolivar Peninsula, west Galveston Island, and the Strand would no longer be livable or accessible. Pelican Island and Galveston's "mid-town" are the only land areas that may remain above the increased sea level.

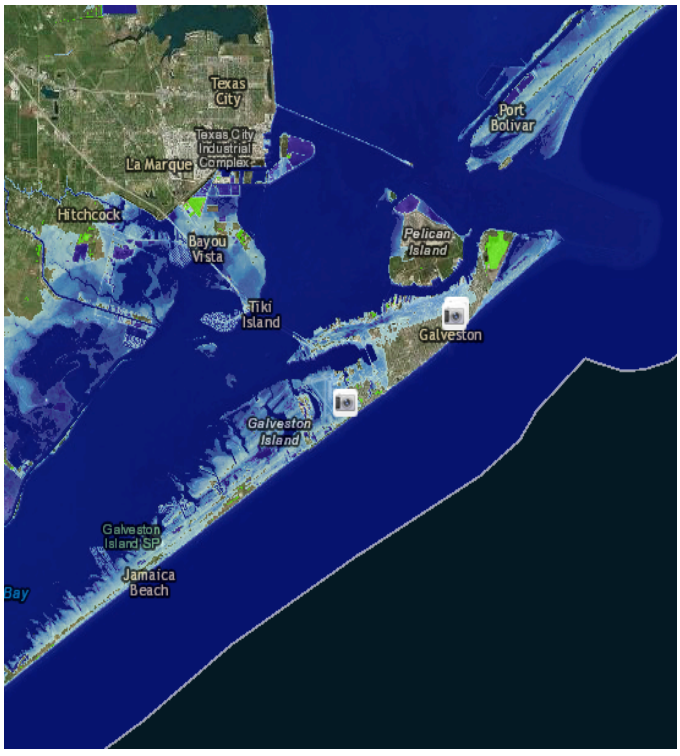
Current Sea Level



3 foot increase

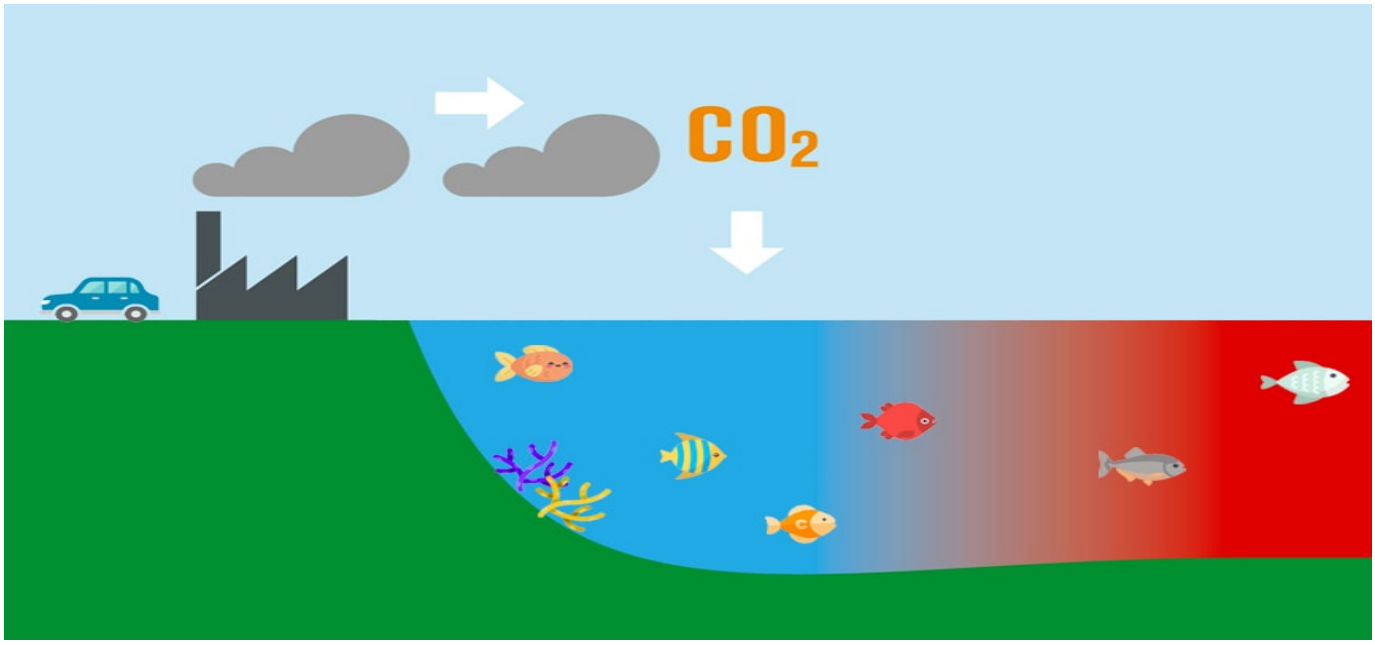


6 foot increase



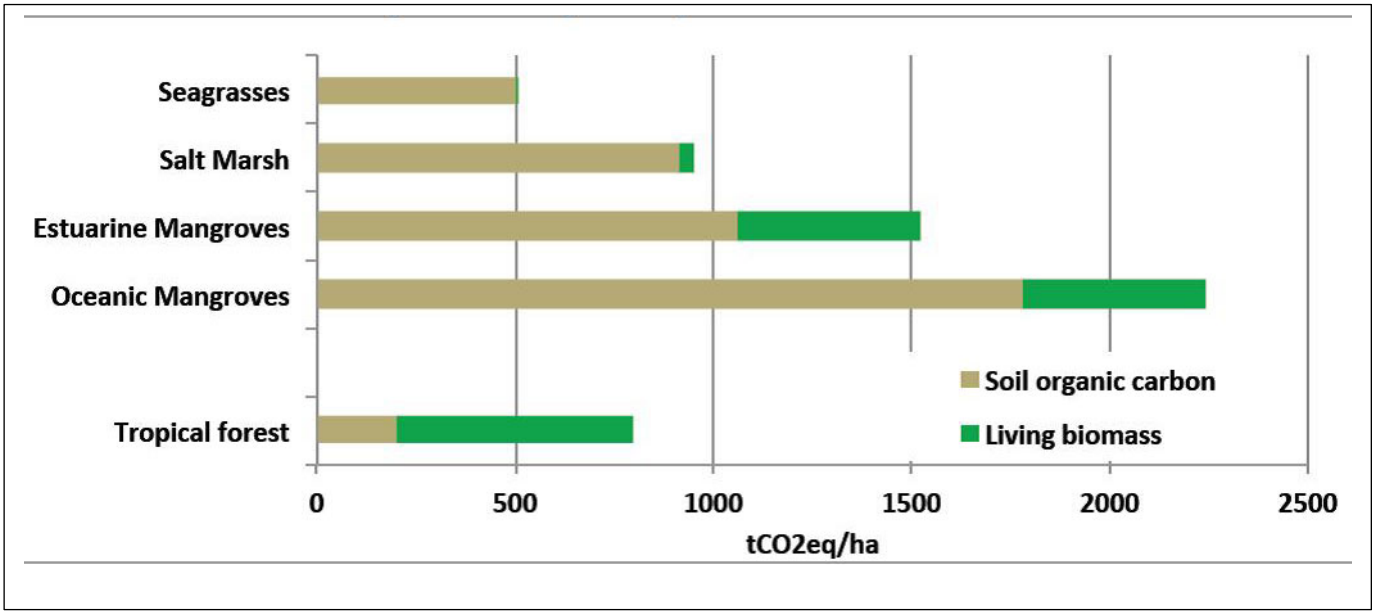
Ocean Acidification

The carbon that does not get trapped in the atmosphere is absorbed by the ocean. Approximately 48% of carbon emitted by fossil fuel burning is sequestered in the ocean. The chemistry of the ocean is being changed by human activity, which affects all sea life. pH stands for "potential of hydrogen" and measures the acidity or basicity of liquids. Sea life has adapted over many years to a specific pH and temperature in the ocean, so even small fluctuations can cause drastic changes in their ecosystem. Water has a pH of 7, while seawater is slightly basic at 8.1. Many marine organisms such as coral, oysters, clams, and mussels have calcium carbonate shells or skeletons. When the pH of the ocean lowers, the calcium carbonate begins dissolving and the animals that use it to form their shells and exoskeletons cannot survive.



Carbon Storage

As the world population grows, our carbon footprint increases. We use more electricity, drive more cars, and require more industry. The biggest sources of CO_2 emissions consist of 87% use of fossil fuels, 9% land use changes (i.e. deforestation), and 4% come from industrial processes. Tropical forests store carbon in their biomass, while salt marshes and mangroves take in CO_2 through photosynthesis and store large amounts of carbon in the soil. This makes ecosystems that store carbon in their soil capable of storing 10x more carbon than traditional forests. Oceanic mangroves store the most atmospheric carbon overall.



MISCONCEPTIONS:

Some think that carbon is only used in the form of fuel (i.e. coal, oil, natural gas), but in reality, carbon is essential to life. Carbon is the primary component of almost everything in your body, including proteins, fats, DNA, sugars, and muscle tissues. Carbon dioxide gas is used when plants photosynthesize. Carbon in the form of graphite is used in pencils, while carbon as activated charcoal is used for filtration and purification. Carbon as diamonds are used for cutting large pieces of rock and stone.

PREPARATIONS:

1. Label one plastic tub "Sea Ice" and a second plastic tub labeled "Land Ice".
2. Have ice and eggs ready for use in a cooler.
3. Label one plastic bin " Salt Marshes", one "Mangroves", one "Tropical Forests", and one "Seagrasses".

INTRODUCTION:

What are the 5 functions of wetlands?

- Flood prevention, water filtration, erosion prevention, nursery habitat, and Blue Carbon sink

What bodies of water contribute to the Galveston watershed?

- Trinity River, San Jacinto River, Galveston Bay, and Gulf of Mexico

Identify different kinds of animals in the Galveston watershed.

- Oysters, clams, dolphins, sharks, shrimp, crabs, fish

GUIDED PRACTICE:

Sea Level Rise

Have 1 tub labeled "Sea Ice" with water and a handful of ice inside. Use an expo marker to mark the initial sea level. During each class period, mark the sea level again. Note how it does not change. Label a second tub "Land Ice". Fill the tub with the same amount of water as the first. Add 3 cups of ice each class period and mark the sea level. Note how the sea level is rising. Revisit the experiment on Day 2 to discuss the final results.

Carbon Storage Visual

Have one plastic bin labeled " Salt Marshes", one "Mangroves", one "Tropical Forests", and one "Seagrasses". Ask students to hypothesize how many black ping pong balls (representing soil organic carbon) and how many dark green ping pong balls (representing living biomass) will be in each ecosystem. Have students take turns tossing ping pong balls into correct bins to visualize their hypothesis. Sort ping pong balls correctly following this activity. Seagrass bin will have 1 dark green and 5 black ping pong balls. Salt Marsh bin will have 1 dark green and 10 black ping pong balls. Mangroves bin will have 27 dark green and 33 black ping pong balls. Tropical Forest bin will have 21 dark green and 2 black ping pong balls.

INDEPENDENT/GROUP PRACTICE:

Ocean Acidification

Split students into groups. Have students formulate a hypothesis about how an egg would be affected by vinegar. Assign each group a different amount of vinegar that is to be added to a plastic cup, being sure that at least one egg is fully submerged. Explain to the students that vinegar is slightly acidic. Allow the egg to remain in the vinegar overnight. Revisit the experiment on Day 2 to discuss the final results.

Reflection

Have students discuss how they can reduce carbon emissions in their day-to-day life. Some examples include drinking from reusable water bottles, walking short distances instead of driving, turning off lights when not in a room, unplugging devices when not in use, and recycling.

ASSESSMENT OF LEARNING:

Monitor students by asking student to document and share their individual practice results from the ocean acidification activity.

CLOSING:

As you teach lessons linked to Blue Carbon, you can use the “I Wonder” board as a closing assignment.

You might ask what else the students want to learn about reducing their carbon emissions or our impact on the environment. Students may ask about ocean acidification harming marine life, sea level rise causing physical harm to the human population, or differences in salt marshes and mangroves. 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 the Gulf of Mexico to be housed.

NOTES: