GULF RESEARCH PROGRAM
NATIONAL ACADEMIES Sciences Engineering Medicine

CARBON FOOTPRINT ASSESSMENT

DE LEVEL	6
ERIALS	○ 2 large, clear, plastic cups of water ○ 20 biodegradable packing peanuts and 20 regular packing peanuts - paper towel - cardboard packaging - paper bag - 2 natural fiber rope - canvas bag or wood - plastic bag - aluminum can - batteries disposable diaper plastic toothbrush coffee pod fishing line or Mardi gras beads plastic water bottle glass bottle old electronics Styrofoam or tinfoil
	choices consumers have, and evaluate their carbon footprint via online tools related to consumption-based in researched data sets.
ECTIVES	• Define carbon dioxide and its effect on the environment • Understand the concept of a carbon footprint
NMENT	TEKS 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

	6.5 (C) – Differentiate between elements and compounds on the most basic level OCEAN LITERACY PRINCIPLES 6. The ocean and humans are inextricably interconnected. CLIMATE LITERACY PRINCIPLES 2. Climate is regulated by complex interactions among components of the earth system. 3. Life on earth depends on, is shaped by, and affects climate. 5. Our understanding of the climate system is improved through observations, theoretical studies, and modeling. 6. Human activities are impacting the climate system.
VOCABULARY	• **Biodegradable** – can be decomposed by a living organism • **Chemical element** – a substance that cannot be broken down by chemical reactions • **Carbon footprint** – the total amount of carbon dioxide emissions associated with all activities of a person that are generated by actions • **Emission** – the production and discharge of something, such as gases, into the atmosphere • **Fossil Fuels** – natural resources that are formed from prehistoric organisms made up of carbon • **Organism** – a living thing
BACKGROUND INFORMATION	*Carbon is a chemical element, represented by the symbol C. Pure carbon exists naturally as graphite or diamond. All life forms on earth are carbon-based, meaning molecules that make up our bodies are built out of carbon atoms. Carbon dioxide (CO_2), found in living organisms, impacts the environment by acting as a greenhouse gas causing heat to become trapped on the earth's surface.* *All living organisms expel CO_2 into the atmosphere when they exhale or decompose. Human industry, including energy, agriculture, transportation, and manufacturing, uses natural resources in the form of fossil fuels containing carbon. When burned, fossil fuels also contribute to CO_2 levels.* *A Carbon footprint is a measurement of the amount of CO_2 released into the atmosphere by our energy consumption. Because we all use energy (electricity and fuel) in our daily lives, we all have a carbon footprint.*

PREPARATION	**Class Period 1:** Fill each of the two plastic cups ¾ of the way full with water. Label six clear bins: >1 year — 1 to 20 years — 100 to 200 years 500 years — ≥1,000 years — Nonbiodegradable **Class Period 2:** Whitelist www.clevercarbon.io on student computers Print the **Carbon Footprint Analysis** worksheets (attached)
INTRODUCTION (First class period)	Begin class with the PowerPoint open to the title slide. Switch to the slide with the photos of different animal tracks on the sand. Ask leading questions to find out what students notice about the creatures that made the tracks – were they heavy or light? Did they have any other impact on the area or were they just passing through? Footprints are evidence that a human or animal has been somewhere. By being there, they changed that place. Some footprints are light and barely noticed, others are deep and have lasting impacts. Advance to the slide with boot prints in the sand. Ask what other signs we might see, smell, or hear that could indicate humans recently passed through an area. (They might mention fire pits, litter, the odor of sunscreen, bug spray, food, smoke, gasoline, tire tracks, dog tracks, engine noise, voices, barking, music, etc.) Point out how a footprint can be anything we leave behind that changes the natural environment. (Advance to Packing Peanuts slide.)
ACTIVITY 1: GUIDED PRACTICE (First class period)	**Packing Peanut Activity** Select 4 students and bring them up to the front of the class. Have each student handle and make observations of the biodegradable and non-biodegradable packing peanuts. Ask the students to compare the packing peanuts and hypothesize what may happen when they are each placed in water. Fill two large, clear plastic cups with water. Have students hypothesize how many biodegradable packing peanuts and how many non-biodegradable packing peanuts will fit into each cup. Select a student to put the decided-on number of biodegradable packing peanuts in one cup. Select another student to put the decided-on number of non-biodegradable packing peanuts in the second cup. The biodegradable packing peanuts will continue to dissolve, therefore never filling the cup. Discuss the results.

	Advance to Slides 5–9 and teach the material about carbon and the effects of CO_2 emissions. Advance to slide 10 (How Long does Waste…)
ACTIVITY 2: GROUP PRACTICE (First class period)	**Pollutant Rate of Breakdown Activity** Find a table space to set up six labeled clear bins. (alternatively, just put the labels on the floor a few feet apart.) Divide students into groups of 2 to 3. Distribute a range of clean, unused consumable products among the different groups so that each group gets one or two items. Explain that everything made from organic compounds (including plastics) will decompose eventually. Ask students how long they think the decomposition takes using the bin labels as time intervals. Have the groups discuss which bin their product belongs in and why. Groups will send one representative up to place the item in the selected bin. Discus their choices as a group, comparing students' expectations to the actual rates of breakdown below: <1 year - Paper towel - Cardboard packaging - Brown paper bag - Natural fiber rope 1-20 years - Canvas bag - Wood - Plastic bag 100 years - Aluminum can - Batteries 500 years - Disposable diaper - Plastic toothbrush - Coffee pods - Plastic water bottle - Monofilament fishing line - Mardi gras beads ≥1000 years - Glass bottle - Electronic devices Non-biodegradable - Styrofoam - Tinfoil Advance to slide 11 to close out the first class period and end on a note of how
ACTIVITY 3: GUIDED PRACTICE (Second class period)	**Carbon Footprint Assessment** Walk through slides 12-14 (Intro to Carbon Footprint) then advance to slide 15. Lead students through the online Carbon Footprint tool at www.clervercarbon.io, Read each question aloud while students answer individually on their devices. Clarify terms and the intent of each question as needed.

	Example: *Commute* = how you get to your daily activities. Riding the bus to school is public transport. Other methods could include carpooling, taking a ferry, or riding an e-bike/scooter. Encourage honesty; assure students that their score is for their information only and has no impact on their grade. Point out that everyone's carbon footprint could be lighter, and this exercise shows us where opportunities exist.
ACTIVITY 3: INDEPENDENT PRACTICE (Second class period)	**Carbon Footprint Analysis** Have students write their score from the previous activity on the attached worksheet. Allow them to reflect on their score and opportunities by completing the first page of the attached **Carbon Footprint Analysis** worksheet. Show the final 3 slides to prepare students to come up with their own ideas for Turning Opportunities into Actions. Concluded the activity with informal discussion; encourage students to share their answers and ideas. Examples may include: - Turn off lights when leaving a room - Use a refillable water bottle instead of disposable ones - Unplug chargers when not charging - Walk or ride a bike to get around (instead of riding in a vehicle) - Take good care of clothing and belongings to keep them out of landfills If they scored "Amazing" in all four categories, ask how they could help a friend or family member to improve.
ASSESSMENT OF LEARNING	During guided practice, individual/group practice, and discussion, gauge students' understanding by requesting full participation from every student. Collect Carbon Footprint Analysis worksheets. Check that students have filled in their quiz results, completed the fill in the blank questions, and considered short-term (and long-term if using extension) actions.
CLOSING	As you teach lessons linked to Carbon emissions, you might ask what else the students want to learn about humans impacting the environment. Students may ask about animal habitats, air quality, climate change, or actions they can take to reduce emissions. Write their comments down and save for the future action project planning workshop, if applicable.
EXTENTION	Upon completing the first side of the **Carbon Footprint Analysis** worksheet, ask Leading Questions:

	1. Which category would your chosen Action help you in—Commuting, Flying, Diet, or Home Energy? 2. What challenges might you face when putting your plan into action, and how will you overcome them? Allow students to engage in deeper reflection on their score and opportunities by completing the second page of the **Carbon Footprint Analysis** worksheet. Discuss the relationship between short-term actions vs. long-term change.
TEACHER NOTES	

GULF RESEARCH PROGRAM
NATIONAL ACADEMIES Sciences Engineering Medicine

ECO-ART WORKSHOP: GALVESTON BAY WATERSHED

DE LEVEL	6
ERIALS	○ 3 clear cups ○ Food Coloring (red, yellow, blue, green) ○ Salt ○ Spartina grass root system ○ 2 empty containers ○ 2 small sponges ○ Saltmarsh container with large sponge ○ Houston city model ○ Plate (for Houston model) ○ Non-Point Source (NPS) kit: • Watershed Model • Model Figurines • Spray bottle • Small bottles
IVITY SUMMA	Students will learn about ecology and develop environmental awareness observational skills, which will result in informed decision making, responsible behavior, and constructive actions concerning wildlife and the environment.
RNING ECTIVES	• Differentiate salt/fresh/brackish water characteristics • Understand threats to Galveston Bay due to pollutants • Identification of Galveston watershed contributing bodies of water
iNMENT	TEKS 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 PRINCIPLES 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.*
PREPARATION	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 one 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 (First class period)	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.
ACTIVITY 1: 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.

ACTIVITY 2: GROUP PRACTICE	**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).
ACTIVITY 3: GUIDED PRACTICE	**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.
ACTIVITY 4: GUIDED PRACTICE	**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 lead to algal blooms when it gets into waterways. 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 cause them to drown or die of poisoning.

	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.
ACTIVITY 5: 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.
EXTENTION	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.
TEACHER NOTES	

GULF RESEARCH PROGRAM
NATIONAL ACADEMIES Sciences Engineering Medicine

ECO-ART WORKSHOP: WATERCOLOR PAINTING

DE LEVEL	
ERIALS	› Scrap Paper › Pencils › Watercolor palettes › Watercolor paper › Water cups › Small Masonite boards - (i.e., clipboard material) at least 5 x 7 inches › Masking Tape › Paper towels › Bucket › Reference Images
IVITY SUMMARY	lents will learn about local coastal ecosystems and the wildlife that inhabits ı by applying new knowledge of watercolor painting techniques and ting a watercolor painting.
RNING ECTIVES	• Understand threats to the environment due to pollutants • Recognize the value of protecting the environment • Identify coastal wildlife species
iNMENT	S Science 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 Art 1(A) – Identify and illustrate concepts from direct observation, original sources, personal experiences, and communities such as family, school, cultural, local, regional, national, and international 1(B) – Understand and apply the elements of art, including line, shape, color, texture, form, space, and value, as the fundamentals of art in personal artworks using art vocabulary appropriately 2(A) – Create original artworks based on direct observations, original sources, personal experiences, and the community 2(C) Produce artworks, including drawings, paintings, prints, sculptures/modeled forms, ceramics, fiber art, photographic imagery, and digital art and media, using a variety of materials OCEAN LITERACY PRINCIPLES 1. Earth has one big ocean with many features 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	• **Brackish –** A mixture of salt and fresh water • **Contour Line** – A line on a map joining points of equal height above or below sea level • **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 • **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 identifiable sources, such as wastewater treatment plants, industry, or large chemical/oil spills • **Transparency** – Being able to see through (or partially see through) one or more layers in an artwork • **Salinity** – Dissolved salt content of a body of water; measured in ppt (parts per thousand) • **Watercolor Painting** – A work of art executed with watercolor paint • **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 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.* ***Watercolor Painting Techniques*** *1. **Wash** - paints are applied to wet paper to create soft blending effects. Remember to work from light to dark. Use this technique for the larger areas, such as the sky, water, or ground. To do this, wet the brush without paint, spread it over the paper as if there were paint on it, add some color to the paintbrush, and paint over the area with water. This technique allows paints to be spread evenly and lightly for background colors.* *2. **Wet brush, dry paper** – the brush loaded with both paint and water and applied to dry paper. This technique is used to create shapes with well-defined edges such as large land masses, animals, or plants and can be done on top of a dried wash layer.* *3. **Dry brush** – this technique involves using less water on the brush and applying paint to dry paper in order to create details. Create a small pool of water in the color well that you are wanting to use, then pinch out the excess water left in the paint brush. Gently hold the bristles of the paint brush over the small pool of paint and allow the paint to be absorbed up into the brush.*

PREPARATION	1. Tape a 4.5 x 6 in. piece of watercolor paper to a board – Masonite clip bards work great(enough for the first class period at minimum) 2. Fill a cup half-way with water for each student 3. Gather reference images of local coastal wildlife https://www.inaturalist.org/places/galveston-county is a great source for reference pictures.
INTRODUCTION	Provide students with reference images of local coastal wildlife (i.e. marine mammals, fish, coastal prairie mammals, birds, invertebrates). Have each student choose 3 unique images that they would consider for their watercolor painting. Allow students to quickly sketch each of these images and discuss the importance of contour lines in a painting. Ask students to partner up and discuss why they chose the images they did and determine what could be pros and cons of painting each of the images.
ACTIVITY 1: GUIDED PRACTICE	**Watercolor Painting Demonstration** 1. Quickly choose a subject from provided resources. 2. Decide if the composition will be made in portrait or landscape format. 3. Perform a quick contour line drawing of the subject, and other major parts to the painting. It is easier to look at the drawing while doing this instead of focusing on your hand, similar to playing a video game. Establish a horizon, and the ground or water should meet the horizon line. Encourage students to avoid using elementary symbols such as happy-faced suns, fake fluffy clouds, m-shaped birds. 4. Sketch white areas to avoid painting over them. There is no white paint. 5. Show the class that the watercolor set includes only 12 colors; encourage students to mix custom colors in the wells of the lid. 6. Show examples of how to paint using the 3 main watercolor painting techniques: wash, wet paint – dry paper, and dry brush. 7. Invite students to ask questions about the techniques or upcoming independent practice.

ACTIVITY 2: INDEPENDENT/GROUP PRACTICE	**Equipment Rules** 1. Do not touch supplies until asked to do so. 2. Pour out dirty water and get fresh water for the next group. 3. Paint wells should be cleaned with paper towel after each use. 4. Paint brush must be washed out and placed in paint palette with pencil. 5. Replace reference images. 6. Remove painting and stack board. 7. Throw used paper towels and tape in the trash. **Watercolor Tips** 1. First decide which paper orientation best fits your drawing—portrait or landscape. 2. The subject should fill about two-thirds of the composition. 3. Paint a background behind animal to create the illusion of depth. 4. Foreground—objects such as plant stems or rocks partially overlapping in front of the animal, further creates the illusion of depth. 5. Work from light to dark with watercolors. Save black for last if needed. 6. Contour line drawing defines the outer edge of any shape. Make a simple line drawing of the subject. Leave detail for painting. Students should only spend 5 minutes on contour line drawing. **Watercolor Painting** 1. Have students choose which of the 3 sketched images (completed during the introduction activity) they would like to use as reference for their watercolor painting. 2. Transfer the sketch to their 4.5 x 6 in. watercolor paper or create a new sketch that reflects information learned throughout this watercolor painting Eco-Art Workshop. 3. Allow students to begin watercolor painting. 4. Walk around the room while students are water coloring to assist. 5. Provide frequent updates on time remaining. 6. Have students clean up their work area, leaving it as clean as when they started. Pour out dirty water and refill with clean water
ASSESSMENT OF LEARNING	Informal viewing of artwork will show that students have gained the ability to contour line draw and watercolor paint used the three main techniques.

CLOSING	As you teach lessons linked to Watercolor Painting: An Eco-Art Workshop by Artist Boat, you can use the “I Wonder” board as a closing assignment. You might ask what else the students want to learn about different ecosystems within the Galveston Bay watershed, watercolor painting, or specific species in their own backyards. Students may ask about artists who are known for their watercolor paintings or coastal food chains. 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 the Galveston Bay watershed, the Gulf of Mexico, and local wildlife to be housed.
TEACHER NOTES	

Student-Led Decision Making in STEAM-Powered Blue Carbon Place-Based Experiences

KAYAK INQUIRY WORKSHOP

EFRAME	ninutes
TERIALS	○ Refractometer w/ pipet ○ Turbidity tube ○ Plankton tow net ○ Dip net ○ Seine net ○ Picture of species caught in net ○ Species Identification Guide ○ Digital pool thermometer ○ Nitrite and Nitrate test strips ○ 3 Beakers or cups ○ Lemon juice ○ Distilled water ○ Digital lab scale ○ Portable velocity flow meter Whirling hydrometer Ph test strips Soil probe/core sampler Station cards 5-to-10-gallon bucket of water 5-to-10-gallon bucket ¾ filled with soil and/or wet sand Weigh papers or coffee filters Salt All-purpose flour Small scoop Small bowl Roasting pan (or similar)
RNING ECTIVES	• Understand how scientists measure the impacts of human activity on marine environments • Practice designing an inquiry-based question • Connect scientific practices to the collection of quantitative data
JNMENT	6.3 (A) – Observations are active acquisition of either qualitative or quantitative information from a primary source through the senses

	6.3 (B) – Inferences are conclusions reached on the basis of observations or reasoning supported by relevant evidence 6.6 (A) – Ask questions and define problems based on observations or information from text, phenomena, models, or investigations 6.6 (B) – Use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems OCEAN LITERACY PRINCIPLES 1. Earth has one big ocean with many features. 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. CLIMATE LITERACY PRINCIPLES 2. Climate is regulated by complex interactions among components of the earth system. 3. Life on earth depends on, is shaped by, and affects climate. 5. Our understanding of the climate system is improved through observations, theoretical studies, and modeling. 6. Human activities are impacting the climate system.
VOCABULARY	● **Scientific Inquiry** - a form of questioning, investigating, and problem-solving that helps people come to a greater understanding of the natural world. ● **Evidence** - the available body of facts or information indicating whether a belief or statement is true or valid. ● **Relevance** – the extent to which information is related to a given topic of interest, advances our understanding of that topic, and/or provides useful insights. ● **Citizen science** - the practice of public participation and collaboration in scientific research ● **Complete list** – a record of all the organisms you could identify, including the quantity of each, while engaging in a deliberate effort as a naturalist ● **Bio-diversity** - the variety of life in a particular habitat or ecosystem ● **Biomass** - the total quantity or weight of organisms, living or dead, in a given area ● **Turbidity** - how cloudy or hazy a fluid is, measured with a turbidity tube ● **Salinity** – how salty a fluid is, measured with a reflectometer

	• **pH (parts Hydrogen)** - how acidic or basic a substance is, measured with test strips and reported on a scale of 0 to 14 • **Velocity** - the speed of something in a given direction • **Humidity** - the amount of water vapor in the air, measured with a hydrometer • **Saturation** - the state in which a substance has taken up as much space as it can within another substance • **Nitrites NO_2/Nitrates NO_3** – chemical compounds found in green vegetables and useful for pant growth • **Phytoplankton** - small and microscopic plants that drift or float in the sea or fresh water • **Core Sample** - a cylindrical piece of material taken from underground or the subsurface using a special drill • **Peat** - dark, spongy, soil-like material that is formed when plant material partially decays in waterlogged wetlands • **Acrotelm and Catotelm** – the upper and lower layers of peat in a wetland, which differ in biomass, water content and permeability • **Permeable/impermeable** – how much a material can allow liquids or gasses to pass through it
BACKGROUND INFORMATION	**Inquiry-based Learning** The purpose of this workshop is to prompt students to ask scientific questions about water quality, ecosystems, and the relationship between pollution and climate that will lead them to action. Rather than tell them what questions to ask or what actions to take, inquiry-based learning helps students understand what they could learn about coastal wetlands through data collection and citizen science. **Galveston Bay Water Quality** Current information on the health of Galveston Bay can be found at www.galvbaygrad.org **Expected Results for Station Completion** See attached Station Completion Record with average ranges for results
PREPARATION	**Class Period 1:** Set up the stations around the room with their tools and Station Cards in place **Class Period 2:** Set up the Station Cards only (not the tools and other supplies) around the room.

Commented [1]: when does the action happen?

INTRODUCTION	Explain that citizen science involves careful observation of nature. Through citizen science, community members contribute to data monitoring and collection programs in order to increase scientific knowledge. Examples: 1. People who enjoy birding can help scientists track populations of birds by making a **complete list** of the species they are able to identify, where they were seen and how many of each, and reporting their data on websites like eBird or iNaturalist. This helps scientists learn when a species' habitat or range is shifting or if it is becoming endangered. 2. Beach cleanups like SPLASh TX help scientists collect data on the amount of plastics and litter (by weight) along Texas shorelines. In this workshop, students will learn some of the data collection methods they can use as citizen scientists when they go on their Kayak Adventure.
ACTIVITY 1: GROUP PRACTICE (First class period)	**Using Measuring Instruments for Environmental Science** Demonstrate how to use the flow meter and explain what it measures. (See attached Station Card for instructions.) Define velocity and any other terms that students ask about. Divide class into small groups at each of the remaining stations and designate one to read the instructions aloud, using the STOP sign method to define any terms that are unfamiliar. As each card is discussed, show the PowerPoint slide with a photo of the tool and pictures of that tool being used in the field. Explain what that test is for and what could be learned from it. For example: Nitrates = plant matter -> does tap water have plants? It shouldn't, so we should have low nitrates in this sample. Should there be more or less nitrates in the field where we will be testing? There should be more due to the plant life that is present. Now that everyone knows what the words mean, direct students to work through the instructions at each station in their group and each fill out their results on their Station Record Sheet. Rotate stations on a set timer based on the number of stations and time remaining in the class period. (Allow 5-10 minutes at the end for closing.) Regroup after students have rotated through all the stations for sharing and discussion. Collect station Completion Records.

CLOSING (First class period)	Prepare students for part 2 of the workshop by telling them that they will learn to formulate their own scientific inquiries (or questions) based on the data they can gather in the wetlands using the tools they tried out in this workshop.
ACTIVITY 2: GUIDED PRACTICE (Second class period)	**Formulating a Scientific Inquiry** **Claim Evidence Reason** Explain that scientific inquiry begins with curiosity and investigation. During this workshop they will learn how to ask questions they can only answer by conducting field work (going out of the classroom and collecting data.) Investigation involves looking for more information beyond the initial observation. Additional information may come from closer observation, the surrounding environment, or similar situations. It can also involve taking measurements, tracking changes over time, and finally, consulting experts. "In the previous class period, we learned how to make initial observations (basic data collection.) Now we will learn how to investigate further by developing a scientific inquiry-based question using the attached Kayak Inquiry Planning worksheet." Pass out the worksheets and give them a few minutes to fill out the first question independently. Then, work out the pairings. Be sure to pair students up based on interests. Also consider the pairings size, as they will be paddling together during the Kayak Adventure. Option 1: Have students get up and stand next to the Station Card representing their first choice. Look at the pairings. Move the biggest group to their second choice, and so-on, until there is at least one pair at each station. Option 2: Show a tool and ask for anyone that picked that tool as their first choice to come to you. If more than two people picked that tool have them work out the pairing while you move on to the next tool. They may decide the pairing by playing Rock, Paper, Scissors, or Pick a Number, or even just by having a discussion. When they are paired, tell them "This is your partner for the Kayak Adventure. Write their name on your worksheet."
ACTIVITY 3: INDEPENDENT/GROUP PRACTICE (Second class period)	**Evaluation and Choosing an Inquiry-based Question** Ask if anyone knows what relevance means, then give the definition above. Explain that if the answer to a question isn't interesting or won't help us understand the world better, the question isn't relevant.

Commented [2]: I think this could be a critical moment for the creation + retention of those questions

Deleted: ↵

Deleted: ¶

Deleted: ¶

Commented [3]: I think there's some grounding that can start here -- ie "this is the question that you will be investigating while you kayak" or "this question will guide your kayak trip"

<table>
<tr><td></td><td>Working in their pairs, have them brainstorm inquiry-based question using the attached “Question Storming” portion of the worksheet.

Gather students together and ask them to sort their questions into those that can and cannot be answered using the instrument they chose. Assist the groups in rewriting their questions to fall within the parameters of the location (channel/wetlands/bay, shallow/deep, open water/shoreline) and the tool.

Additionally, determine that the questions are relevant using the following matrix:

<table><tr><td></td><td>Measurable and Relevant</td><td>Measurable but not Relevant</td></tr><tr><td></td><td>Relevant but not Measurable</td><td>Neither Relevant nor Measurable</td></tr></table>
Collect the worksheets.</td></tr>
<tr><td>ASSESSMENT OF LEARNING</td><td>During guided practice, individual/group practice, and discussion, gauge students’ understanding by listening and answering questions for struggling students and asking guiding questions.</td></tr>
<tr><td>CLOSING</td><td>Help students prepare for their Kayak Adventure by telling them what to expect and asking if they have any questions or concerns. Tell them to wear comfortable, fast-drying clothing that can get dirty, closed-toe shoes that stay on (no crocs or flip flops), and to bring bug spray and sun protection. Assure them that they will see wildlife, including specific species as appropriate for their Adventure location.) Tell them about safety precautions will be taken such as wearing life jackets, guides bringing marine VHF radios and first aid kits and being trained in rescuing techniques and explain that the kayaks are very safe as long as they are used as directed.</td></tr>
<tr><td>EXTENTION</td><td>Compile the partner and claim information from the worksheets to provide to the teacher and the guide before kayaking as a reminder for the students.

Provide the compiled list in the program folder as well.</td></tr>
</table>

Commented [4]: important to define these with students

Commented [5R4]: also an opportunity to sprinkle in some EAC here! talk about if it's important *to them* and why, if it's relevant to their local community/lived experience

NOTES	During the Kayak Adventure the guide needs to adaptively manage the time to include two testing sites, lunch and art. This could look like: - Everyone tests at the launch site - Strong paddlers test while waiting for the rest of the group to catch up - Early art/lunch finishers test while others are finishing During the Kayak Adventure the data gathered by the students is recorded on their waterproof notes, then given to the guides, who will put the data into the Kayak Inquiry Database. The complete data will be shared with the teachers to be used for graphing data sets.

Commented [6]: Curious what the post-kayak-trip debrief is like!

GULF RESEARCH PROGRAM
NATIONAL ACADEMIES Sciences Engineering Medicine

BLUE CARBON WORKSHOP

DE LEVEL	
ERIALS	› Expo Marker › 2 plastic tubs › Ice › 5 Clear cups › 5 eggs › Vinegar › 4 plastic bins › 50 orange ping pong balls › 50 white ping pong balls › Laminated legend
IVITY SUMMARY	lents will learn about coastal ecosystems, oceans, and climate by analyzing ›hs and interpreting data.
RNING ECTIVES	• 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
iNMENT	S 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 PRINCIPLES 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 from or caused by 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.

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.
PREPARATION	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?** 1. *Flood prevention* 2. *Water filtration* 3. *Erosion prevention* 4. *Nursery habitat* 5. *Blue Carbon sink* **What bodies of water contribute to the Galveston watershed?** 1. Trinity River 2. San Jacinto River 3. Galveston Bay 4. Gulf of Mexico **Identify different kinds of animals in the Galveston watershed.** Oysters, clams, dolphins, sharks, shrimp, crabs, fish
ACTIVITY 1: 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.

<table>
<tr>
<td>ACTIVITY 2: GUIDED PRACTICE</td>
<td>
Carbon Storage Visual

Have one plastic bin labeled " Salt Marshes", one "Mangroves", one "Tropical Forests", and one "Seagrasses". Ask students to hypothesize how many white ping pong balls (representing soil organic carbon) and how many orange 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.

<table>
<tr><th></th><th>White (Soil Organic Carbon)</th><th>Orange (Living Biomass)</th></tr>
<tr><td>Seagrasses</td><td>5</td><td>1</td></tr>
<tr><td>Salt Marsh</td><td>10</td><td>1</td></tr>
<tr><td>Mangroves</td><td>33</td><td>27</td></tr>
<tr><td>Tropical Forest</td><td>2</td><td>21</td></tr>
</table>
</td>
</tr>
<tr>
<td>ACTIVITY 3: INDEPENDENT/GROUP PRACTICE</td>
<td>
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.
</td>
</tr>
<tr>
<td>ASSESSMENT OF LEARNING</td>
<td>Monitor students by asking student to document and share their individual practice results from the ocean acidification activity.</td>
</tr>
</table>

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.
TEACHER NOTES	

GULF RESEARCH PROGRAM
NATIONAL ACADEMIES Sciences Engineering Medicine

BLUE CARBON INTERPRETIVE ART WORKSHOP

DE LEVEL	
ERIALS	› Scrap Paper › Interpretive art themes › Watercolor palettes › Watercolor paper › Water cups › Large watercolor boards (9 x 12) › Masking Tape › Paper towels › Bucket › Reference Images
IVITY SUMMARY	lents will learn about coastal ecosystems, oceans, and climate by analyzing ›hs and interpreting data in an artistic way.
RNING ECTIVES	• Understand threats to the environment due to pollutants • Recognize the value of protecting the environment • Identify coastal wildlife species • Understand watercolor painting techniques
iNMENT	S Science 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 Art 1(A) – Identify and illustrate concepts from direct observation, original sources, personal experiences, and communities such as family, school, cultural, local, regional, national, and international 1(B) – Understand and apply the elements of art, including line, shape, color, texture, form, space, and value, as the fundamentals of art in personal artworks using art vocabulary appropriately 2(A) – Create original artworks based on direct observations, original sources, personal experiences, and the community 2(C) Produce artworks, including drawings, paintings, prints, sculptures/modeled forms, ceramics, fiber art, photographic imagery, and digital art and media, using a variety of materials OCEAN LITERACY PRINCIPLES 3. The ocean is a major influence on weather and climate 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	• **Anthropogenic** – Originating from or caused by human activity • **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 • **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 • **Interpretive Art** – An art pieces that communicates information or a message about a topic with the aim of inspiring interest or action

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.

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.

	Interpretive Art *An interpretive art piece is created using knowledge of a topic to highlight key points, and aims to encourage viewers to take action.* *Three examples of methods of creating interpretive art are:* 1. *Visualizing data as a graph with artistic elements to emphasize a point* 2. *Transforming an ordinary item into something extraordinary* 3. *Spreading a message of hope* ***Watercolor Painting Techniques:*** *1. **Wash** - paints are applied to wet paper to create soft blending effects. Remember to work from light to dark. Use this technique for the larger areas, such as the sky, water, or ground. To do this, wet the brush without paint, spread it over the paper as if there were paint on it, add some color to the paintbrush, and paint over the area with water. This technique allows paints to be spread evenly and lightly for background colors.* *2. **Wet brush, dry paper** – the brush loaded with both paint and water and applied to dry paper. This technique is used to create shapes with well-defined edges such as large land masses, animals, or plants and can be done on top of a dried wash layer.* *3. **Dry brush** – this technique involves using less water on the brush and applying paint to dry paper in order to create details. Create a small pool of water in the color well that you are wanting to use, then pinch out the excess water left in the paint brush. Gently hold the bristles of the paint brush over the small pool of paint and allow the paint to be absorbed up into the brush.*
PREPARATION	1. Tape a 9 x 12 in. piece of watercolor paper to a wooden board (enough for the first class period at minimum) 2. Fill a cup half-way with water for each student 3. Gather reference images of local coastal wildlife
INTRODUCTION	Review what Interpretive art is with the students and explain the different themes that they will chose from, followed by examples. Spread out and display interpretive art references out on an accessible table. Hand-out a piece of scratch paper to each of the students.

	Demonstrate how each student will fold their scratch paper into 4 equal sections. Ask the students to quickly sketch a picture in each of the squares that illustrates one of the many topics discussed during the other NAS-PBE workshops based off of the three different themes. For inspiration, have students utilize the art references and leave the 'Example Ideas' slide on the screen. Encourage students to begin thinking about different ways to tell a story through an art piece.
ACTIVITY 1: INDEPENDENT/ GUIDED PRACTICE	**Interpretive Art Equipment Rules** 1. Do not touch supplies until asked to do so. 2. Pour out dirty water and get fresh water for the next group. 3. Paint wells should be cleaned with paper towel after each use. 4. Paint brush must be washed out and placed in paint palette with pencil. 5. Replace reference images. 6. Remove painting and stack board. 7. Throw used paper towels and tape in the trash. **Watercolor Painting Demonstration** 1. Quickly choose a subject from provided resources. 2. Decide if the composition will be made in portrait or landscape format. 3. Perform a quick contour line drawing of the subject and other major parts to the composition. It is easier to look at the drawing while doing this instead of focusing on your hand, similar to playing a video game. If depicting a landscape, establish a horizon, and the ground or water should meet the horizon line. Encourage students to avoid using elementary symbols such as happy-faced suns, fake fluffy clouds, m-shaped birds. 4. Sketch white areas to avoid painting over them. There is no white paint. 5. Show the class that the watercolor set includes only 12 colors; encourage students to mix custom colors in the wells of the lid. 6. Show examples of how to paint using the 3 main watercolor painting techniques: wash, wet paint – dry paper, and dry brush. 7. Invite students to ask questions about the techniques or process.

	Interpretive Art Act Have students transfer their chosen interpretive art sketch to the 9 in x 12 in watercolor paper. Walk around the room and provide feedback while students are water coloring. Provide frequent updates on time remaining. With the 'Clean up' slide on the board, have students clean up their work area following the rules, leaving it as clean as when they started. Students will then write their first and last name, as well as the date on their art piece.
ASSESSMENT OF LEARNING	Informal viewing of work will show that students have gained the ability to paint a picture that tells a story, evokes emotion, and encourages taking action.
CLOSING	As you teach lessons linked to Blue Carbon Interpretive Art, you can use the "I Wonder" board as a closing assignment. You might ask what else the students want to learn about interpretive art or reducing their carbon emissions. Students may ask about additional artists who create interpretive art pieces, ocean acidification harming marine life, or sea level rise causing physical harm to the human population. 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.
TEACHER NOTES	

GULF RESEARCH PROGRAM
NATIONAL ACADEMIES Sciences Engineering Medicine

ACTION PROJECT PLANNING

DE LEVEL	6-8
ERIALS	○ NOAA Environmental Action Planning Worksheets: - "Moving from Claims to Informed Action" Worksheets (1 per student) Find at: www.noaa.gov/sites/default/files/2022-10/6_NOAA_BWET_MWEE_Moving_from_Claims_to_Informed_Action.pdf - "Environmental Action Planning" Packet containing: "Budget", "Maintenance", 'Listing Contacts", "Asking for help: Drafting a Request", "Drafting a Request, Continued", and "Task Management" (1 per group) Find at: www.noaa.gov/sites/default/files/2022-10/8_NOAA_BWET_MWEE_Environmental_Action_Planning.pdf
IVITY MARY	The students will design, create, and implement their own Environmental Action Projects that will provide a solution to their Driving Questions by using the information, tools, resources, and data gained through the Kayak Inquiry Adventure
RNING ECTIVES	• Students will bring their projects from the ideas stage to the implementation stage • Students will practice project management skills • Students will increase their knowledge of existing environmental issues and will work towards developing/implementing solutions to these issues • Students will connect with Experts and stakeholders, use real data, and
iNMENT	TEKS 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 6.7.(A) – Research and debate the advantages and disadvantages of using coal, oil, natural gas, nuclear power, biomass, wind, hydropower, geothermal, and solar resources CLIMATE LITERACY PRINCIPLES 2. Climate is regulated by complex interactions among components of the earth system. 3. Life on earth depends on, is shaped by, and affects climate. 5. Our understanding of the climate system is improved through observations, theoretical studies, and modeling. Human activities are impacting the climate system. OCEAN LITERACY PRINCIPLES 1. Earth has one big ocean with many features 2. The ocean and life in the ocean shape the features of Earth 3. The ocean is a major influence on weather and climate 4. The ocean makes Earth habitable 5. The ocean supports a great diversity of life and ecosystems 6. The ocean and humans are inextricable interconnected 7. The ocean is largely unexplored
VOCABULARY	• **Environmental Action Civics** - An educational approach where youth work in partnership with adults to identify a local environmental issue and engage with community members to take action by advocating for systemic changes to policies/practices • **Environmental Action Project** - A project that addresses the root cause or problem of a community issue and has a long-term impact; example - implementing a permanent recycling process on a school campus • **Service Project** - A project that addresses an immediate, short-term need in the community; example - volunteering time to clean up litter from the beach
BACKGROUND INFORMATION	*The culmination of this program is for students to implement an environmental action project that will provide a solution to their driving question using information gained throughout the curriculum. This will look different for each group based on their curiosity and questions.*

	*An **environmental action project** is a project that addresses the root cause or problem of a community issue and has a long-term impact.* *A **service project** is a project that address an immediate, short-term need in the community and can include volunteering time to clean litter off the beach. (This is what the students want to avoid implementing)* ***Environmental Action Projects** can take many forms and may fall into the following types:* o ***Restoration or Protection**: actions that assist in the recovery or preservation of a watershed or related ecosystem that has been degraded, damaged, or destroyed. Examples include: plant or restore protective vegetation/trees; restore a local habitat; remove invasive plants; develop a school garden, natural history area, community garden, or other sustainable green space; install rain gardens to help manage stormwater.* o ***Everyday Choices:** actions that reduce human impacts on watersheds and related ecosystems and offer ways to live more sustainably. Examples include: refuse/reduce/reuse/recycle; monitor and save water in the face of potential drought or reduction in water availability; compost food or yard waste; research and implement energy efficient strategies or energy alternatives at school and/or at home.* o ***Community Engagement:** actions that inform others about how to address community-level environmental issues. Examples include: give presentations to local organizations; organize community events; record or broadcast public service announcements; share information on social media; post flyers in community; share posters at community events/fairs/festivals; mentoring.* o ***Civic Engagement:** actions that identify and address issues of public concern. Students acting alone or together to protect societal values or make a change or difference in a student's school, neighborhood, or community. Examples include: present to school principal or school board; attend, speak, or present at town meetings; write to local or state decision makers or elected officials.*
PREPARATION	**Period 1:** Pass out "Moving from Claims to Informed Action" worksheet to each student. **Period 2:** Pass out "Environmental Action Planning Worksheet" packet to each group. **Period 3:** Pass back out packets for finalizing action planning. **Period 4 and more:** Provide materials based on budgeted items.

INTRODUCTION (First class period)	**Developing a CLAIM** You can support students in brainstorming action ideas and then choosing a single project to carry out as a class or small group in many different ways. These instructions describe one way of how you might transition from the "Moving from Claims" to "Informed Action" worksheet with the "Choosing an Action Project" worksheets. Adapt and create alternatives that meet your class's needs. • Using the "Moving from Claims to Informed Action" worksheet provides space for students to brainstorm possible solutions to their environmental issue. The prompts on the left-most column can be helpful in building out concepts. This can be done individually or in pairs, and ideally students come up with at least three distinct ideas. Encourage innovative and divergent thinking. A. Remind students of some topics that have been discussed throughout the curriculum using the "What? So What? Now What" debrief method. Suggested questions below. • *What are some things that we learned over all the workshops?* • *What did you find interesting from those lessons?* • *How did those interests lead to your Kayak Inquiry Question? How did we answer it?* • *So, what can we do with that information?* • *Now, what Environmental Action Project can we create?* • *What issue can it address?* • *What would the results be from that?* • *So, what should we do to sustain the solution to this issue?* B. Then allow students time to write down their CLAIM—a statement identifying an environmental problem that needs to be solved. C. Discuss the difference between a service project and an environmental action project by having students suggest examples of different types of projects that are helpful. Respond by identifying it as either a service project or environmental action project. Then, offer additional examples and have them identify which type of project each is. D. Then have students brainstorm three solutions to the claim they wrote down in the "what Actions could be taken to address the environmental issue" row. Have them trade with a neighbor and cross off any solutions that are service projects instead of action projects. If students are unsure, encourage them to ask the educator.

ACTIVITY 1: GUIDED PRACTICE (First class period)	**Developing a SOLUTION** 1. You can now organize students into small groups of similar claims to discuss and debate their ideas. Read one student's claim and ask any other students with the same topic to join that student. Continue until all students are in a group. Large groups should be split based on the solutions. Four groups is a manageable size for a classroom of 20 students. A. The focus is now on convergent thinking. Task each group with developing a few solutions they would want to carry out in order to take action on the issue. They should answer the next two questions "How would this action help to address the issue" and "what resources would you need to make it happen?". Express the four following types of Environmental Action Projects: *Restoration or Protection, Everyday Choices, Community Engagement, and Civic Engagement*. It may help to write these terms on the board and discuss the definitions and examples of the categories. B. Introduce the concept of criteria, or a set of "standards" on which decisions are based, in order to decide which solution to move forward with. The group will use these standards to narrow down the options and arrive at a final selection. It can help for there to be teacher-created criteria as well as student-created criteria. Examples of teacher-created criteria may include restrictions around timing (e.g., the project must be completed in two class periods) or funding (e.g., the project must cost less than $50). Encourage students to think about what they value most when they create criteria. Examples of student-created criteria may be around impact (e.g., will this make substantial change in our community) or interest (e.g., will this project be fun to work on). Add the criteria to the board so everyone can see the list. Have students evaluate their solutions based on the new criteria and adjust or delete an idea. C. Finally, engage the groups in voting on the action project solutions that are left in their own groups. This can be done as a discussion or students can vote individually and tally the results. One strategy may stand out as the clear winner. If one does not emerge naturally, students may need to establish additional criteria or use a different kind of voting technique to come to consensus. Or perhaps, students can brainstorm a way to merge the ideas and execute aspects of both. D. By the end of the session, the group should have a succinct one-sentence description of their action project idea written at the bottom of their worksheet and their group mates names at the top.

ACTIVITY 2: GROUP PRACTICE

(Second Class Period)

Developing a PLAN

Now that students have an idea, they need assistance turning it into a plan. Have student's sit in their solution groups and give each a copy of the packet. Have each group separate the packet and distribute the pages so each person is in charge of one page, but remind them that each part correlates to another so encourage group work. Explain the concept of each page in the packet and then allow the groups time to brainstorm. Remind the students that this project will take course over 4 weeks and data collection must be obtained from it. This also includes promotion of the project as well. Walk the room assisting those groups that get stuck or by offering suggestions.

1. **Task Management**: Have students think through all the steps of their project and write them down in any order on the task management sheet. Continue adding tasks to the list as they discuss their project. The educator should give suggestions for tasks as they walk the room and keep a running list on the board for all to see including:
    - Research current actions
    - Meet with experts
    - Take actions
    - Share success information with stakeholders
    - Celebrate
    - Thank those who helped

    Once groups have exhausted their list of tasks, they should number their list to put it order and assign a group member to that task and a completion date so that all milestones are hit.

2. **Listing Contacts**: On the Listing Contacts worksheet student groups should list five people that they might need to get help from. If they do not know the actual person's name, they can write the job title such as City Manager or Principal. Next tot eh person's name the students will write why they need the assistance of that person. Encourage them to be as specific as possible because they may actually need to speak to someone other than the person listed once they explain why. For example if the group wants to paint a mural on the front of the school depicting the zones of the ocean, they will need permission from the superintendent not the principal.

3. **Drafting a Request**: Students will use the drafting a request page to plan out what they need more specifically from each person on their contacts list. This will help them write letters of assistance.

	4. **Budget**: The budget worksheet will help students understand what supplies they will need to complete their project. All needed supplies should be listed even if the group gets them for free or they can borrow it. A list of classroom items that can be used is helpful to get the supplies list started. If a group needs an item with a cost, the group should brainstorm how they might get this item (parent, Principal, company, etc). This person should be added to the listing contact sheet. 5. **Maintenance**: On this worksheet students will brainstorm what maintenance their project might need. This will vary from none at all for a letter writing campaign to weekly if planting a nativescape. Encourage student groups to think through the whole project and how they can create something lower maintenance or how to create a thorough maintenance plan.
ACTIVITY 3: GUIDED PRACTICE (Third Class Period and onward)	Once the action projects are planned, students must implement their PLAN, collect at least 4 weeks of data, and gather the data into some form of presentable report. Supplies must be ordered and distributed to the groups. Students will need time either in or outside of class to meet and complete their assigned tasks. Artist Boat Eco Art Educators will support the classroom teacher during this time through emails, phone calls, and/or scheduled Teams discussions with student groups. The teacher will manage the groups and keep the projects moving forward to completion.
EXTENSION: (End of 4 weeks)	**CELEBRATION** Once the projects are all complete, share the students' successes and collected data with the larger community. This might look like a District- wide STEM night, a Poster Presentation in the school halls, or a sharing event in the classroom. Whichever format you choose, it is important to create an atmosphere of celebration around student's accomplishments by, for example, inviting guests, encouraging applause, giving out certificates of recognition, offering refreshments, etc.
ASSESSMENT OF LEARNING	During guided practice, individual/group practice, and discussion, gauge students' understanding by requesting full participation from every student. Collect NOAA Action Planning Worksheet and packets and check that students have filled in their responsibilities. Return the worksheets and packets with verbal feedback for the students and teachers.

CLOSING	As you teach lessons linked to Action Projects, you might ask what else the students want to do about humans impacting the environment. Students may ask about civic action, who holds decision making power, and who they can talk to and what affect their actions may have. Write their comments down and save for the implementation of the action projects.
EXTENTION	
TEACHER NOTES	