

Beach Exploration

Grades 3 – 4



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Beach Exploration

For most people, going “down the shore” means heading to the beach, with a car loaded with blankets, chairs, umbrellas, boogie boards, coolers, and all the other trappings of the modern vacation. By the time all that gear is spread across the sand, few people stop to think about the beach itself. Where did the sand come from? What else lives there? Why doesn’t grass grow on the beach? How did the seashells get there?

Beaches are actually full of life, and changing constantly with the push and pull of Mother Nature. Not just a sandy wasteland, a beach is home to many kinds of marine life, not just the seagull that tries to steal your lunch. If you know what you’re looking at, you can read the ever-changing story of the beach. So, let’s take a closer look!

This booklet contains information to help you and your students prepare for your trip to The Wetlands Institute. The accompanying activities are designed for before and after sessions and are intended to enhance the learning experience of your visit. However, feel free to use the activities in a manner best suited to the needs of your students.

PRE-VISIT ACTIVITIES

1. Before visiting the beach, students should hone their observation skills, so they’ll be ready to look for the harder-to-see animals that live in the sand. **Outdoor Observer** lets them practice observing nature closer to home.
2. All living things have similar needs for food, water, and shelter. In **All Living Things Have Needs**, students will see that seashore plants and animals have needs much like those of humans, but that those needs are satisfied in different ways.
3. Your student’s knowledge of the beach may come from the Hollywood point-of-view. They may not realize that the beach isn’t patrolled by “Baywatch” lifeguards, that Sponge Bob and Patrick don’t really live there, and that “Free Willy” doesn’t actually frolic in the surf. They’ll compare their pre-trip expectations to what they actually see, in **Beach Before and After**.

POST-VISIT ACTIVITIES

1. Animals can’t live without all the components of their habitat. Students will make posters featuring an animal they saw at the beach, and its entire habitat, in **Who, What, Where?**
2. Students will create a **Beach in a Box**, making a shoebox diorama that illustrates the entire beach ecosystem that they’ve explored.

BACKGROUND INFORMATION

A Beach Ecosystem

A beach ecosystem—what is it? The word ecosystem has two parts. “Eco” is a part of the word **ecology**, which is the study of relationships among living things and their environment. A system is made up of parts that form an organized whole, so an **ecosystem** is an organization of living and non-living parts that interact with one another. Ecologists are people who study the interrelationships among living and nonliving parts.

Your students will be beach ecologists on their trip; they will examine both the living and non-living parts of an ecosystem. The non-living components we will discuss are sand, wind and water. The living parts of an ecosystem that we will look at include plants like trees, shrubs, and grasses, and animals, including both vertebrates and invertebrates. We will see how these parts form the beach ecosystem.

Sand

Sand is a non-living component of the beach ecosystem that affects every organism living there. It is the home for many a turtle and horseshoe crab egg, and the gritty end to our walk home from the beach. The texture, particle size, temperature, and even moisture content of the sand affect the organisms that live and below it. Sand ranges in color from black to pink to beige to white, but every type of sand is a mixture of ground up rocks and/or shells. Sand on the shores of New Jersey is made primarily of **quartz**, a mineral that is white or clear in appearance. **Calcium carbonate**, derived from shells ground down by ocean wave action, is another large component of sand in New Jersey. Calcium carbonate gives the sand its glittery, shiny white appearance.



New Jersey Beach Sand

Wind and Water

The most important quality of the ocean water is its **salinity**. Salinity is a measure of the amount of salt in water. Ocean water is much saltier than rainwater, or the water from a kitchen faucet; ocean water contains about 30-35 parts per thousand salts. To understand what this unit of measure means, imagine 30 pounds of salt added to 970 pounds of water to make a mixture totaling 1000 pounds. 30 parts out of the total 1000 parts are comprised entirely of salt.

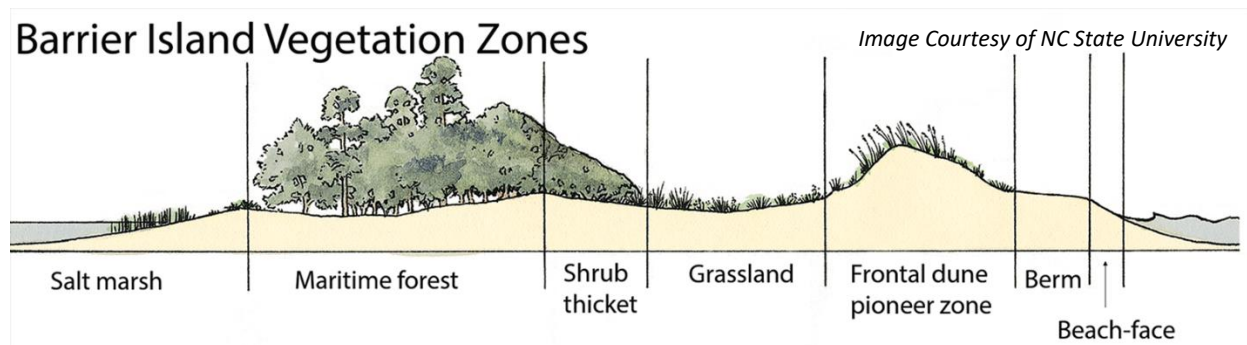
The billions of pounds of salt in the ocean originally came from rocks lying deep on the ocean floor that contained salts, which dissolved in the ocean water. Today, streams wash more salt into the ocean as they pass over salt-bearing rocks. The ocean's salinity levels

remain fairly constant, however, because of the marine organisms that extract salt from the water they live in.

Wind and salt water act in concert in a beach ecosystem. Wind blows over the ocean's surface, and whips up salty spray, which it carries over land. The saline spray dries and consequently "prunes" plants. In these harsh conditions, only certain types of **vegetation** are able to withstand the pressure, or stress, that the wind and water cause and, as such, plants that grow close to the ocean have special adaptations to survive in their demanding environment.

Plants

A walk to the beach provides a great opportunity to see different vegetation types. Ecological **succession** to its fullest extent in a beach ecosystem produces three zones of vegetation, which, when grouped together, are called the **dune system**. Succession is a term that describes the evolution of vegetation types that inhabit an area. Grasses are some of the first plant types to grow on a bare patch of land. Grasses are followed by low-lying plants like shrubs, and after shrubs establish themselves, tree species are more likely to grow. The dune system is comprised of the **primary dune**, which contains grasses, the **secondary dune**, characterized by grasses and shrubs, and the **maritime forest**, which contains a unique mixture of shrub and tree species.



The zone closest to the ocean is the primary dune. Salt spray, wind, and hot sun eliminate all trees and shrubs from growing in this area. Beach grass, a tall and thin grass, exists almost exclusively in the primary dune. Beach grass slows the erosion of sand dunes by anchoring sand in place. Extensive root systems called **rhizomes** spread horizontally, as well as, vertically down into the soil, securing the grasses in the sand. The interwoven network of the roots below and the grasses above the sand slows the movement of sand across dunes, allowing the dunes to better hold their shape. Maintaining the geological integrity of sand dunes is important to animals, like shorebirds, that make their nests in the primary dunes. Additionally, people who enjoy beaches for active and passive recreation depend on the dunes for their pleasure. Beaches don't exist without sand, and sand does not stay in place without plants in the dunes to anchor it.

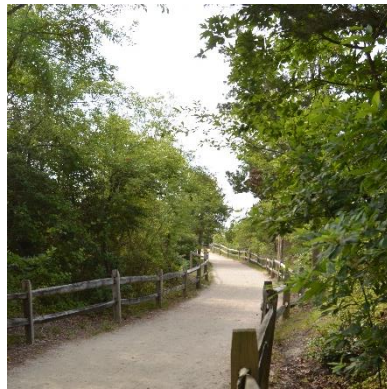
Tall trees and some shrubs define the maritime forest, the zone furthest from the beach. To say the maritime forest is a forest which grows close to the ocean is to tell a half-truth, for while this forest grows close to the ocean, so may other forest types. The maritime forest separates itself

from other forest types by the presence of short, twisted-limbed trees, a lack of large-leaved trees (such as oak or maple), and an abundance of plants tolerant of salt water spray.

In a beach ecosystem, vegetation exists in the water, as well as, on land. Several different types of seaweed are evident in the shore areas of New Jersey. Sea lettuce is a one to two cell layer thick type of seaweed. It floats, unattached, in chartreuse-colored sheets often tattered with holes because of its delicate thinness. Another seaweed, rockweed, is beautifully designed. It contains visible air bubbles that allow it to float and receive sunlight close to the water's surface. While walking along a New Jersey shoreline, you may also see coarse red weed, a highly branched, thin, salmon red colored seaweed.



Primary Dune Grasses



Maritime Forest Vegetation



Rockweed

Animals

A beach ecosystem contains both **vertebrate** and **invertebrate** animals. The vertebrates are animals with a backbone like fish and birds. The animals lacking a backbone, the invertebrates, include animals like horseshoe crabs, ghost crabs, mussels, and clams.

Fish announce their presence on the beach usually only with skeletal remains. Even a dead fish that washes ashore isn't whole for long, as shorebirds will pick away the meat, leaving the bones.



Adult Laughing Gull

The most memorable animal on many trips to the beach may be the gull—the infamous sandwich stealer. In a beach ecosystem, that doesn't include hungry sunbathers, however, gulls prefer eating crabs. There are many species of gull, each with different colors and names. The herring gull is a white bird with a grey back, a little smaller than a chicken. People often see herring gulls feeding on crabs and mollusks on beaches, or ocean side docks. The laughing gull, another gull species, is most easily recognized by its white body, black head and loud distinguishable call. Laughing gulls feed on shelled animals by the ocean, though they are known to eat a beachgoer's lunch if that person isn't watchful.

For our purposes, the invertebrate animals on a beach are divided into two categories: **arthropods** and **mollusks**. The arthropods include insects, arachnids, and **crustaceans**; and mollusks include both **bivalve** and **univalve** animals.

Students walking along the sandy beach will find shells, which are protective coverings for soft-bodied mollusks. The surf clam and mussel are two mollusks that often wash up on New Jersey beaches. The surf clam is a whitish, plain looking mollusk. It is a bivalve, meaning its two shells join together with two valves to create a seal, covering the soft animal inside. Clams are a favorite food of the herring gull. Another commonly found bivalve shell is the mussel. Mussels often grow in groups, anchoring themselves along pilings and hard surfaces. Mussels and clams are called filter feeders, since they filter their food from the seawater by drawing water in, retaining organic matter, and expelling the excess water. Univalves (single-shelled animals with only one valve) on the beach include moon snails and whelks.

Dead crabs, or their shells, are another common beach find. Crabs are crustaceans, which means they have a hard **exoskeleton** covering their soft bodies, and jointed, paired legs. There is a possibility of seeing blue claw crab, lady crab, and spider crab shells while walking in the **intertidal zone**, though most often people find lone crab shells or individual claws. The intertidal zone covers the area of beach that stretches from the high tide water line to the low tide line.

Intact dead crabs are a rare find because herring gulls and laughing gulls quickly rip apart and gobble up dead crabs. The crab and shorebird interactions form an important part of the beach ecosystem. Without the shore- birds, dead crabs would pile up on the beach, and without the crabs, the shorebirds would lose a large and important food source.



Speaking of birds and crabs, what about the horseshoe crab and the shorebirds that depend on it for food? The horseshoe crab, an arthropod related to scorpions and spiders, forms another vital piece of the ecological puzzle of a beach ecosystem. Horseshoe crabs come onto beaches to spawn, and leave hundreds of thousands of tiny olive green eggs that shorebirds will eat to re-fuel after a 4-5 day migration from South America. You probably won't see any egg-laying activity during your trip, but look for horseshoe crab shells on the beach.



If you're lucky, you may see a live horseshoe crab! Don't be afraid to touch the horseshoe crab; though it has 10 legs and claws, and a pointed tail, it is not harmful in any way. Be careful not to pick up a horseshoe by its tail because, not only is the tail harmless, it is also very fragile, and can break off if used to pick up the horseshoe crab.

*Horseshoe Crab Eggs (Top) and
Adult Horseshoe Crabs Spawning (Bottom)*



Ghost Crab

Two other crustaceans, the ghost crab and mole crab, are often found live on the beach. Ghost crabs scuttle across the sand, almost undetectable, because of their sandy coloring. They spend most of their day excavating the holes they live in under the hot sand, sweeping out sand blown in by the wind. Another type of crab, a mole crab, is fairly easy to find and plentiful on most beaches. Unlike the spider and blue claw crabs, which live in the ocean water, a

mole crab spends its life under the water in the moist sand of the intertidal zone. A mole crab is an inch long, blind creature, with a beige, translucent body. People can find mole crabs by digging several inches into the sand, and scooping that sand into a sieve and rinsing with seawater.



Mole Crab

Some beach animals have live birth of young, some have eggs, and some have egg cases. The whelk and the skate are part of the last group. Skate egg cases and whelk egg cases are both exciting surprises for people who have never seen them before. A skate egg case, also known as a mermaid's purse, is a remnant left by young skates that hatched out of the case. A skate is an animal with a similar shape to a manta ray. The knobbed whelk egg case is a series of flat beige discs strung together. Each individual disc contains 20-100 tiny whelk shells, a couple millimeters long at the largest. Carefully breaking the individual discs open reveals shells similar in appearance to a conch, the whelk's southern relative. Don't worry about breaking the cases, the whelks aren't alive if they've been lying on the hot sand.



Clearnose Skate and Egg Case



Knobbed Whelk and Egg Case



Channeled Whelk and Egg Case

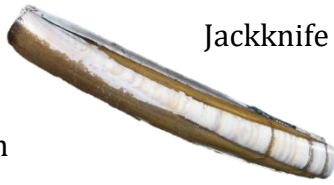
SUPPLEMENTAL BACKGROUND INFORMATION

Take a deeper dive into the beach using the following two supplemental information guides: *On the Beach* and *Sand's Story*.

On the Beach: A Few Common Things for Beachcombers



Soft Shell Clam



Jackknife Clam



Ribbed Mussel



Hard Clam

Surf Clam



Blue Mussel



Eastern Oyster



False Angel
Wings



Slipper Shell

Bay Scallop



Skate Egg Case

Knobbed Whelk



Moon Snail Shell



Horseshoe Crab



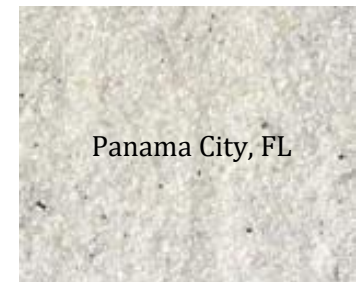
Channeled Whelk



Sand's Story: What to Learn from the Color of Sand



This grouping of samples illustrates the gradual transition of sands from north to south along the East Coast. Because the predominant wave direction is from the northeast, sand is slowly transported south. With age, the darker minerals are broken down, leaving only the whitish quartz grains. Thus, the sand lightens with age as it moves south.



Outdoor Observer

The beach is a place that, upon first glance, doesn't seem to have many living things on it other than birds. Students will practice their science techniques by observing and recording the different kinds of living things they find in a local natural area. Mindful observation is beneficial for student attention spans, patience, and sensitivity to material. It may also encourage their natural curiosity.

Materials:

- Paper and pencil
- An outdoor location such as the student's backyard, a local park, nature center or anywhere outdoors with observable wildlife and activity

Procedure:

1. Have students guess (and write down) how many living things they think they will see during their observation time.
2. Once guesses have been made, instruct students to find a nice spot to sit outside, and observe their surroundings. Fifteen minutes should be suitable for every child; long enough to see a number of different organisms while holding their attention.



- While the student sits, they should be quiet and still and watching for living things. Remember that people and their pets don't count in the tally of living things—and don't forget that plants do!
3. Once everyone is seated and quiet, begin the observation time. During that time, have the students write down every plant and animal they see, every bird, insect, chipmunk, squirrel, dandelion, and oak tree. If a student doesn't know a name for the living thing, have them write instead a description, or draw a picture of the living thing for possible identification after the activity has finished. The goal is to have the student quiet and alert, listening and looking for living things.
 4. After the observation period ends, discuss with the students what they observed and how what they saw compared with what they predicated at the beginning of the activity.

Extensions:

1. As a class, create a list of all the animals you remember seeing on your visit to the beach. Have your students compare this list of animals to the ones they just created during their observation period. Are there similarities in the types of animals? Are there differences? Compare the habitats.
2. Visit one of the live cameras offered by the Georgia Aquarium or the Monterey Bay Aquarium. Set a timer for 10 minutes. Have your students observe one of the tanks or enclosures. Ask your students to think about these questions and write down their thoughts while they observe.
 - a. What kinds of animals do you see?
 - b. How many animals are there?
 - c. What are they doing?
 - d. Are they excited/sleeping/playing/eating?
 - e. Draw what you see!

<https://www.georgiaaquarium.org/webcam/>

<https://www.montereybayaquarium.org/animals/live-cams>

All Living Things Have Needs

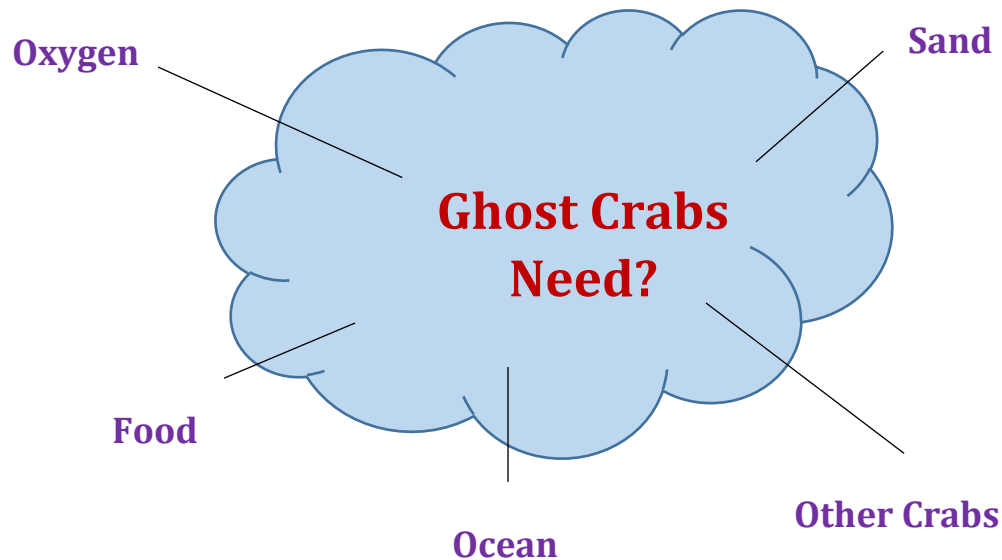
All living things have similar needs for food, water, and shelter. Student will see that seashore plants and animals have needs much like those of humans, but that those needs are satisfied in different ways.

Concepts:

- An organism is a plant or an animal.
- Seashore plants and animals have needs much like those of humans, although they are satisfied in different ways.
- All living things have similar needs – food, water, shelter, and space to survive.

Procedure:

1. Write the words “plants” and “animals” on the board. Ask the students to brainstorm the names of plants and animals. With the students’ help, list under the proper heading. Brainstorm the characteristics of plants and animals. Write the ideas on the board.
2. What plants and animals do the students think they will find at the beach? List these on the board or challenge the students to make a list of all the animals. Who has the biggest list? Students can add to the list over the course of the unit.
3. How are humans and seashore animals alike? How are they different? Write ideas on the board. What does it mean to survive? What do humans need in order to survive?
4. Brainstorm what these different animals need to survive. Split the students into groups and assign each group an animal you previously came up with and wrote on the board. Use the image below as an example.



Extensions:

1. Have your students consider their assigned animal in a different habitat than the beach. How would their animal's needs be met or fail to be met in this new habitat? Have your students consider multiple habitats.
2. Let's get creative! Have your students draw their assigned animal in its habitat. In the drawing be sure the students show a representations of each of their animal's needs being met.

Beach Before and After

Students will write pre-and post-trip ideas about what they will find, and have found, on a beach. They will challenge representations of the beach in popular culture. They will also discover for themselves what kinds of animals live on beaches, and how people use beaches.

Materials:

- Paper
- Pencils

Procedure:

1. ***Before the Beach Exploration Program:*** Have them write a couple of paragraphs about what they think they will see on their trip. The students may base their essays upon images in movies and TV, or, alternatively, their own beach experiences.



2. ***During the Beach Exploration Program:*** Below are several points of discussion to have with students during their Beach Exploration Program. The goal is to spark discussion, while thinking about how human activities affect the plants and animals that live and use the beach.
 - a. Many people view the beach as sand and water, and not an ecosystem or habitat for animals. Beaches for swimming often have a large amount of foot traffic during the tourist season. The large amount of people displaces animals or alters the animals' habitat, making it unsuitable for living.
 - b. Other activities associated with recreational beach enjoyment interfere with a healthy beach ecosystem. For example, beach replenishment projects destroy many types of life. During replenishment, people pour tons of sand onto existing beaches in an effort to slow erosion. The additional sand reduces the numbers and types of animals that live in and above the sand.
 - c. Additionally, raking of beaches, which is done to smooth the surface appearance negatively affects animals like ghost crabs, which live in holes in the sand.

3. ***After the Beach Exploration Program:*** Students will write a second piece about what they noticed on the beach. They can write about anything that they remember seeing. After they have finished writing, have the students read over their previous statements about the beach, and compare their previous ideas with their new, more informed perspective.

Extensions:

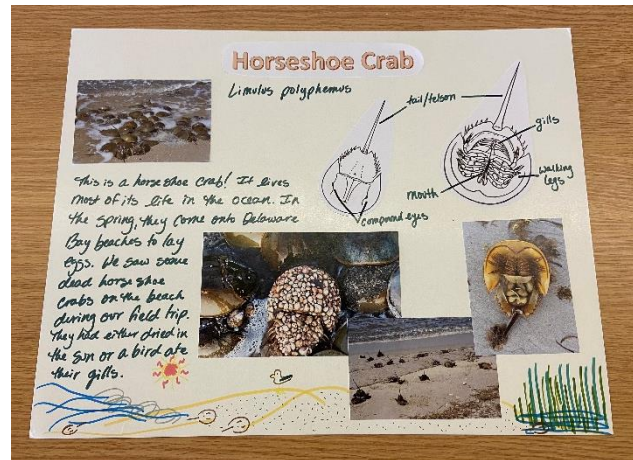
1. Have your students consider the beach in the various seasons. How do the factors that impact life on the beach change depending on the time of year? Discuss as a class and create four lists, one for each season, of the factors that impact animals that live on the beach.
2. One thing your students likely found on their visit to the beach was marine debris. Have your students research marine debris, specifically focusing on what it is and how it impacts the environment. Engage your students in a discussion about how to prevent trash and pollution from becoming marine debris.

Who, What, Where?

Students will make a poster that displays pictures of an animal in its habitat accompanied by written information about the poster's art for this post-trip activity. This project will help reinforce the ideas of living and non-living components that comprise an ecosystem. It is geared toward those students that learn in visual, artistic, auditory, and active ways.

Materials:

- Poster board (1 large piece for each group of 3-5 students)
- Markers, crayons, and/or colored pencils
- Pictures of animals/plants seen on trip



Procedure:

1. Gather pictures of animals the students saw on their trip to the beach. Use photos taken during the trip, search the Internet, or flip through magazines for pictures. Examples include: laughing gulls, horseshoe crabs, blue claw crabs, mussels, and clams.
2. Create different animal workstations around the room. At each workstation, place a picture of one animal species underneath a piece of poster board.
3. Divide students into groups of 3-5 students.
4. Assign one group to each animal workstation station and tell them to lift up the poster board to see what you have hidden underneath.
5. Have the students complete their poster board by:
 - a. Gluing or taping the pictures to the poster board
 - b. Using crayons, markers or colored pencils to draw the other elements (both living and non-living) in that animal's habitat. If the animal can be found in two places, say, alive in the ocean, or washed up dead on the beach, have the students draw the habitat that they found the animal in during their Beach Exploration Program.

- c. Write a paragraph describing what the animal is and what the elements (both living and non-living) are in its habitat.
6. Have each group present their animal species and all the information on their poster board. As a class, discuss what elements of the habitat are represented on the poster board and/or what elements may be missing.

Extensions:

1. After all the students present their poster boards, ask your students to make connections between these animals. Using a long piece of string or rope, create a food web in your classroom discussing how each group is connected to the other groups around them. If you do not have string, draw the food web on the board.
2. Conduct a field study with your class. In a natural area, give your students some time to write down the components of this ecosystem. Ask them to list the living and non-living components. Discuss with your class how this ecosystem is different from the beach ecosystem. How is it the same? When discussing similarities, focus on how many of the non-living components are the same. Highlight the fact that all habitats need five main components; space, water, food, air and shelter.

Beach in a Box

Students will create shoebox dioramas modeled after the beach ecosystem they explored on their trip. The activity is a great way to reinforce the concept of an ecosystem. It is group work that requires creativity and originality. It allows the students to express themselves artistically and also communicate to others about their creations.



Materials:

- Shoe boxes
- Construction paper
- Markers, crayons, and/or colored pencils
- Various crafting supplies, both natural and manmade, including: pipe cleaners, cotton balls, clay, glue, glue, foam, scissors, and/or any other materials that can be cut, molded, or manipulated creatively

Procedure:

1. Divide students into groups of 3-5 students.
2. Set up a shoebox “diorama style” for each group.
3. Explain to the students that they will be recreating what they saw when they explored the beach ecosystem. While accuracy is important, emphasize to the students to use the materials in a creative way, since this is also a creative project. After creating their diorama, they will explain their models to the class, so there should be reasoning as to why components are placed in specific locations or included in the model at all.
4. Allow an hour for model creation.
5. Once completed, allow students to explain their models to the class. Provide facilitated discussion along the way, including general questions like: *What kind of animals live in the water?* and more specific ones like: *Where is the intertidal zone?* or *What does a herring gull eat?*

Extensions:

1. Assign a different habitat (maritime forest, primary dune, secondary dune, intertidal zone, and swash zone) to each student group so that all areas of the beach are represented.

Vocabulary

Arthropod translates to “jointed foot”; a phylum of invertebrate animals that includes, insects, spiders and scorpions, and crustaceans.

Bivalve a class of mollusks with two hard shells joined by two valves to seal in a soft-bodied animal; for example, an oyster.

Calcium carbonate mineral component of sea shells, which, when ground up, make up a portion of beach sand; CaCO_3 .

Crustacean a diverse group of marine arthropods with an exoskeleton and jointed appendages like lobsters, crabs, and shrimp.

Dune system ecosystem comprised of the maritime forest, secondary dune, and primary dune, all of which contain differing vegetation types suited to sun, wind, and salt water conditions.

Ecology study of relationships among organisms and their environments.

Ecosystem grouping of living and nonliving parts that interact to form a whole.

Exoskeleton external skeleton that supports and protects an animal's body; are frequently a characteristic of invertebrate animals.

Intertidal zone area of sand that stretches from the high tide line to the low tide line.

Invertebrate animals without a backbone; for example, a squid or clam.

Maritime forest a part of the dune system; forested area close to the ocean that contains short trees with small leaves, and some vines and shrubs adapted to hot, windy, and moderately salty conditions.

Mollusks phylum of invertebrate animals that includes soft-bodied animals with a shell, most of which have a muscular foot used for motion; for example, clams, oysters, mussels, and whelks.

Primary dune collection of sand closest to the beach, covered only in beach grass; part of the dune system.

Quartz a sparkly white mineral that, when ground finely, comprises a large portion of the sand on New Jersey beaches.

Rhizome a continuously growing horizontal underground stem which puts out lateral shoots and roots at intervals.

Salinity the saltiness or amount of salt dissolved in a body of water.

Secondary dune located between the maritime forest and primary dune; contains shrubs and grasses; part of the dune system.

Succession process by which the mixture of species and habitat in a specific area gradually changes over time.

Univalve a class of mollusks with one valve and one hard shell covering its soft body; for example, a whelk or snail.

Vertebrate animal with a backbone, for example, a fish or horse.