P.I.E.R.

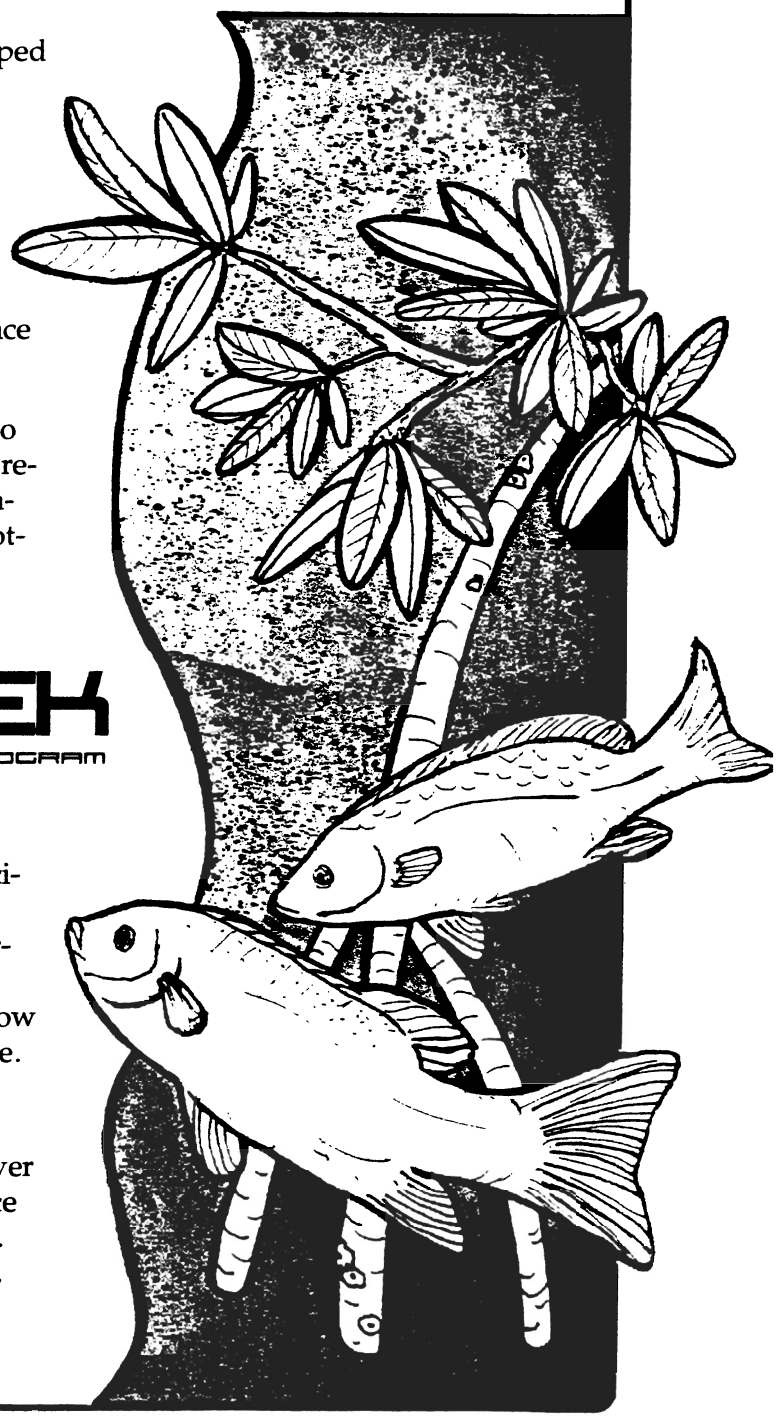
PROTECTION, INVOLVEMENT, EDUCATION, RESTORTATION

SARASOTA bay COASTAL HABITATS

The following section contains material developed by Mote Marine Laboratory's Distance Learning Program (SeaTrek) for P.I.E.R., a program of the Sarasota Bay National Estuary Program.

This material is suitable for **upper elementary** (generally, grades 4-6) and **middle school** (generally, grades 6-8) students and is aligned with National and Sunshine State Science Education Standards (see Appendix A and B).

A companion videoconference program has also been developed by SeaTrek. It features estuary research around Sarasota Bay done by Mote scientist, as well as glimpses of some familiar and not-so-familiar wildlife.



MOTE MARINE LABORATORY

SEATREK

DISTANCE LEARNING PROGRAM

What is SeaTrek?

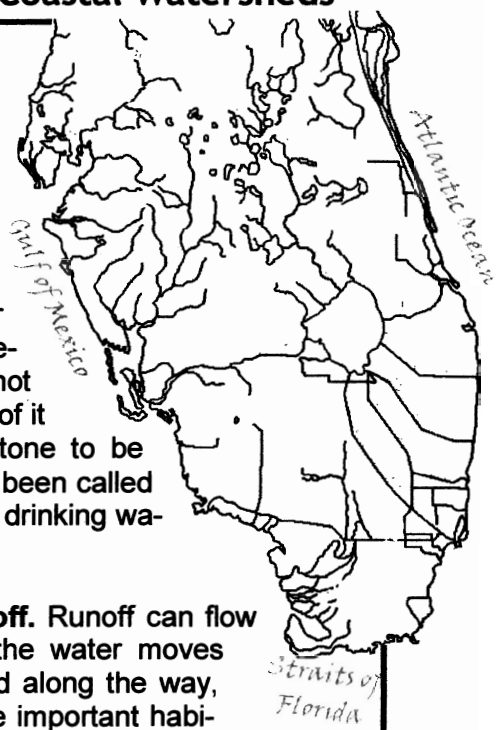
SeaTrek is a high-energy, multimedia marine science program that can come right into your classroom through videoconferencing and Internet technology. Programs feature real scientist working in the field with interviews showing how their interests led them to thier careers in science.

Who can participate?

SeaTrek programs are delivered to schools all over the world. Any school that has a videoconfernece system can connect with us to receive programs. Call **1-800-691-MOTE** or email **seatrek@seatrek.org** for more information. Thank you.

<www.seatrek.org>

A Closer Look: Florida



The Sunshine State is blessed with water, both fresh and salt. Florida is a **peninsula**, surrounded on the east by the Atlantic Ocean, on the west by the Gulf of Mexico and to the south by the Straits of Florida. Some of the fresh water in Florida comes from its neighboring states to the north, in the form of river and groundwater flow. However, the majority of fresh water comes as rainfall. The state averages 50 inches of rain per year, with May through October generally being the wettest period. The landscape of Florida is relatively flat, so water does not drain very quickly compared to more mountainous regions. A lot of it ends up trickling slowly through sandy soil and porous limestone to be stored under the ground in areas called **aquifers.** Aquifers have been called the "rain barrels" of Florida, and a majority of Floridians get their drinking water from this source.

The rain that does not enter the ground becomes surface **runoff.** Runoff can flow into streams and rivers or collect into ponds and lakes. As the water moves through the environment, different kinds of wetlands are formed along the way, such as bogs, sloughs, marshes and swamps. Wetlands provide important habitat for a variety of plants and animals. Wetlands also filter out some of the pollutants that can otherwise build up in the water as it moves downstream.

When the water finally reaches the ocean, it sometimes forms an **estuary.** Estuaries are special kinds of wetlands that are classically defined as semi-enclosed bodies of water where fresh water from the land, usually coming from a river, mixes with salt water from the sea. Because of the sheltered mixing of fresh and salt water, estuaries offer a remarkably rich but ever changing habitat for wildlife. Also, vegetation along the edges of the estuary helps stabilize the shoreline and forms a natural buffer between the land and the eroding energy of the ocean.

Florida Water Fast Facts

- Florida has over 1000 miles of coastline, the most of any of the lower 48 states.
- Florida receives 150 billion gallons of rain fall each day.
- 26 billion gallons of water flow into Florida from neighboring states.
- 70% of the rain fall (approximately 107 billion gallons) returns to the atmosphere through evaporation and transpiration. The remaining rain fall flows into rivers or seeps under the ground.
- Floridians consume 2.7 billion gallons for industrial, agricultural and personal use each day.

Learn more about Florida waters:
<www.swfwmd.state.fl.us/ppr/publications/files/FloridaWatersResources.pdf>

Sarasota Bay, a Florida Estuary

Sarasota Bay, on the southwest coast of Florida, is an example of a semitropical estuary. It first formed about 6,000 years ago, during the most recent sea level rise. The Bay is approximately 56 miles long and includes several smaller embayments (Palma Sola Bay, Sarasota Bay, Roberts Bay, Little Sarasota Bay and Blackburn Bay). It is protected from the Gulf of Mexico by barrier islands (Anna Maria Island, Longboat Key, Lido Key, Siesta Key and Casey Key). The distance across the Bay from the barrier islands to the mainland varies from only 300 feet (around Siesta Key) to 4.5 miles (near the middle of Longboat Key). Most parts of the Bay are shallow

PERCENTAGES TO PONDER

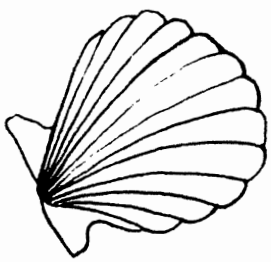
The amount of water on Earth never changes. The same water is here today as there was when the dinosaurs were around or when Chistopher Columbus came to the Americas!

- 97 % of the world's water is in the oceans.
- 3% of the world's water is fresh water.
- Only 1% of the world's water is available for drinking and other human uses.
- 75% of the human body is water!

-low, with an average depth of 5 feet, and a maximum depth (at Longboat Pass) of 27 feet. A series of inlets allow mixing between the Gulf of Mexico and Sarasota Bay (Tampa Bay at Anna Maria Sound, Longboat Pass, New Pass, Big Sarasota Pass, and Venice Inlet), and it is estimated that the water in the bay is totally changed about every 15 days. Much of the rainfall that enters the Bay comes as runoff from creeks and bayous. These mainly include Palma Sola Creek, Bowlees Creek, Whitaker Bayou, Hudson Bayou, Phillippi Creek, Clower Creek, Catfish Creek, North Creek and South Creek.

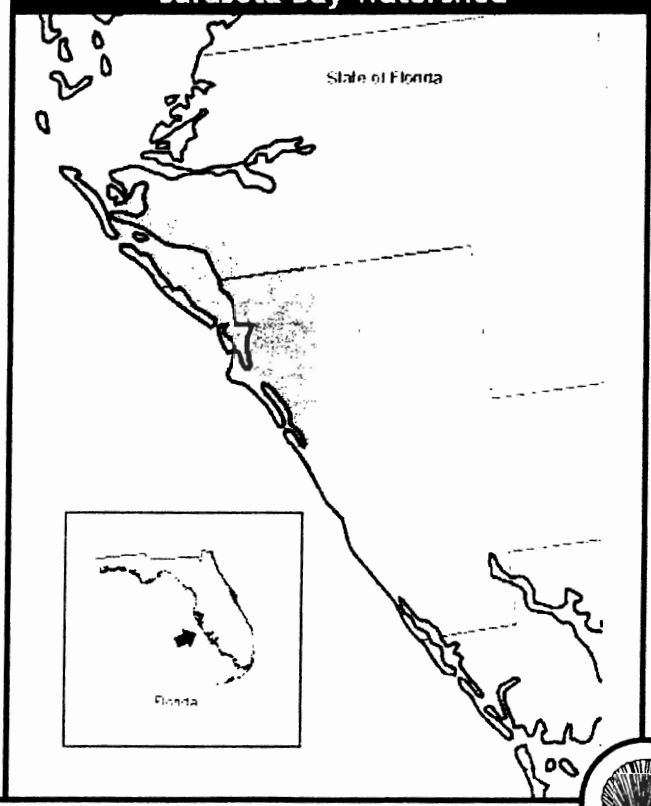
Seagrass meadows, mangrove swamps and other wetlands around the Bay provide habitat for resident and migratory wildlife. People have long been attracted to the natural resources of the coast, both for recreational and commercial purposes. There are burial mounds, middens and other evidence of human habitation in the area that date back over 10,000 years. Modern settlers began arriving in the mid-1800s, mostly in the form of scattered fishing camps. In the 1920s and 30s, the area started to see an increase in population growth that continues today. The increased development of the Bay ultimately led to a decline in the quality of this coastal system. Concern about this decline led to the Bay's inclusion in the National Estuary Program in 1987, and to the formation of the Sarasota Bay National Estuary Program (SBNEP) in June 1989.

The SBNEP is charged with improving and protecting Sarasota Bay. This is accomplished in several ways, principally through monitoring and controlling pollution, restoring and improving natural habitat, researching current and future conditions of the Bay and sharing that knowledge through education. SBNEP works with other governmental and private institutions, as well as concerned citizens, to meet these goals. ♦



The scallop is one of two animals used in the SBNEP logo. Do you know the other one?

Sarasota Bay Watershed



Activity 1.1: Create a Simple Model Watershed

Grade Level: 4-6

Standards: see Appendix A and B.

Time Required: 30 to 50 minutes.

Objective: Students will get a general idea of what happens to the water that flows through a watershed by making a simple model using paper, markers and a spray bottle.

Materials:

- ❑ One sheet of white construction or notebook paper per student
- ❑ Water-based color markers
- ❑ One or more shallow pans
- ❑ One or more spray bottles filled with water

Suggested Procedures:

1) Give each student a sheet of white construction paper or let them use notebook paper. Have them crumple it up a little. It is not necessary to make a ball.

2) Have the students partially smooth out their crumpled sheets, leaving some wrinkles and ridges (represent peaks and valleys).

3) Have them use markers to trace the ridges. They should make a network of lines. They can use different color markers to represent different kinds of pollutants, such as pesticides, litter, soil and fertilizer.

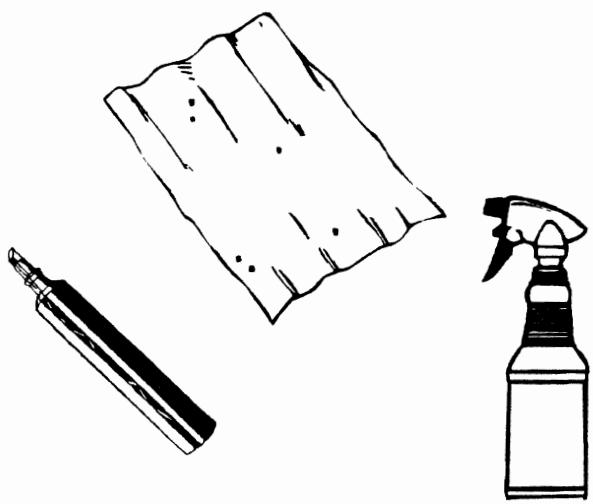
4) Allow each student to place their paper in a shallow pan. If there are enough spray bottles, allow the students to gently spray the top of their papers. Otherwise, the teacher may spray the sheets for the students. The papers should be just wet enough to allow the colors to begin spreading.

Discussion: Have the students describe what happens at the lowest point of their model watershed. Have them identify where the different colors mix together (at the high points or low?). Ask them what they think happens in an actual watershed when pollutants mix together.

Extension: If time and resources allow, student can make more complex models using art supplies such as cardboard, papier mache and foil. Instructions and examples for this kind of activity are available in Activity 5.1 and on the Internet:

- <www.swfwmd.state.fl.us/infoed/waterweb/waterwebwatersheds.pdf>
- <www.coast-nopp.org/resource_guide/elem_mid_school/ma_habitats_acts/journey.html>
- <www.tnrcc.state.tx.us/exec/sbea/tes/lessons99/wetlandwatershed.html>
- <www.heath.k14.mass.edu/water.html>

Adapted in part from: Southwest Florida Water Management District. Watershed Excursions Tabloid, Teacher's Guide. 09/02. <www.swfwmd.state.fl.us/watershd/pdf/teachguide.pdf>



Activity 1.2: Mapping Your Watershed

Grade Level: 6-8

Standards: see Appendix A and B.

Time Required: 30 to 50 minutes.

Objective: Students will identify major waterways and features of the Sarasota Bay Watershed and learn their own geographical relationship to them.

Materials:
- Pencils or pens
- One (1) copy of Activity Sheet 1.2.1 for each student or group of students
- Atlases of Florida, maps of Sarasota and Manatee counties and/or nautical charts of Sarasota Bay
- Access to Internet sites like Mapquest, Mapblast or Terraserver (optional)

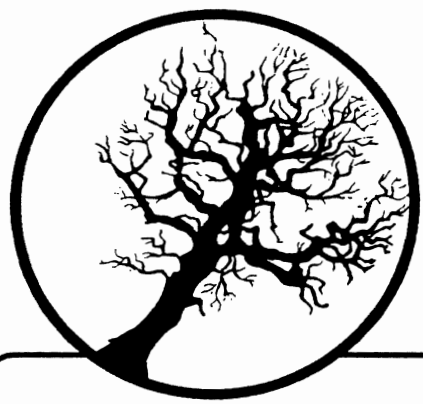
Suggested Procedures:

1) In this activity, students will become familiar with the geography of the Sarasota Bay Watershed. Using atlases of Florida, maps of Sarasota and Manatee counties, nautical navigation charts or Internet-based map sites, have the students locate the land and water features listed on Activity Sheet 1.2.1. Note: students may work in cooperative learning groups if map resources and Internet access are limited.

2) Have the students label these features on Activity Sheet 1.2.1. The location of Palma Sola Bay is already indicated for them, as an example of how to label the map. In addition, have them try to identify the approximate location of their school and/or the location of their house. If they find other waterways or features not listed above, let them include it on their map and share it with their classmates.

3) Review Activity Sheet 1.2.2 with the students and allow them to fill in any areas they may have missed.

Discussion: Ask the students if they have ever been to any of the places on their maps. If they have taken boat trips on the Bay or canoed along its creeks, have them write a page about what it was like to be on the water. Alternatively, let them describe their trips to the rest of the class and learn what aquatic encounters they might have shared with other students who have been to the same place.



IS THIS A TREE OR A WATERSHED?

From the air, the meandering streams and rivers of a watershed sometimes look like the silhouette of a tree. This water systems have also been compared to the intertwining networks of the human nervous system. Can you see the resemblance?

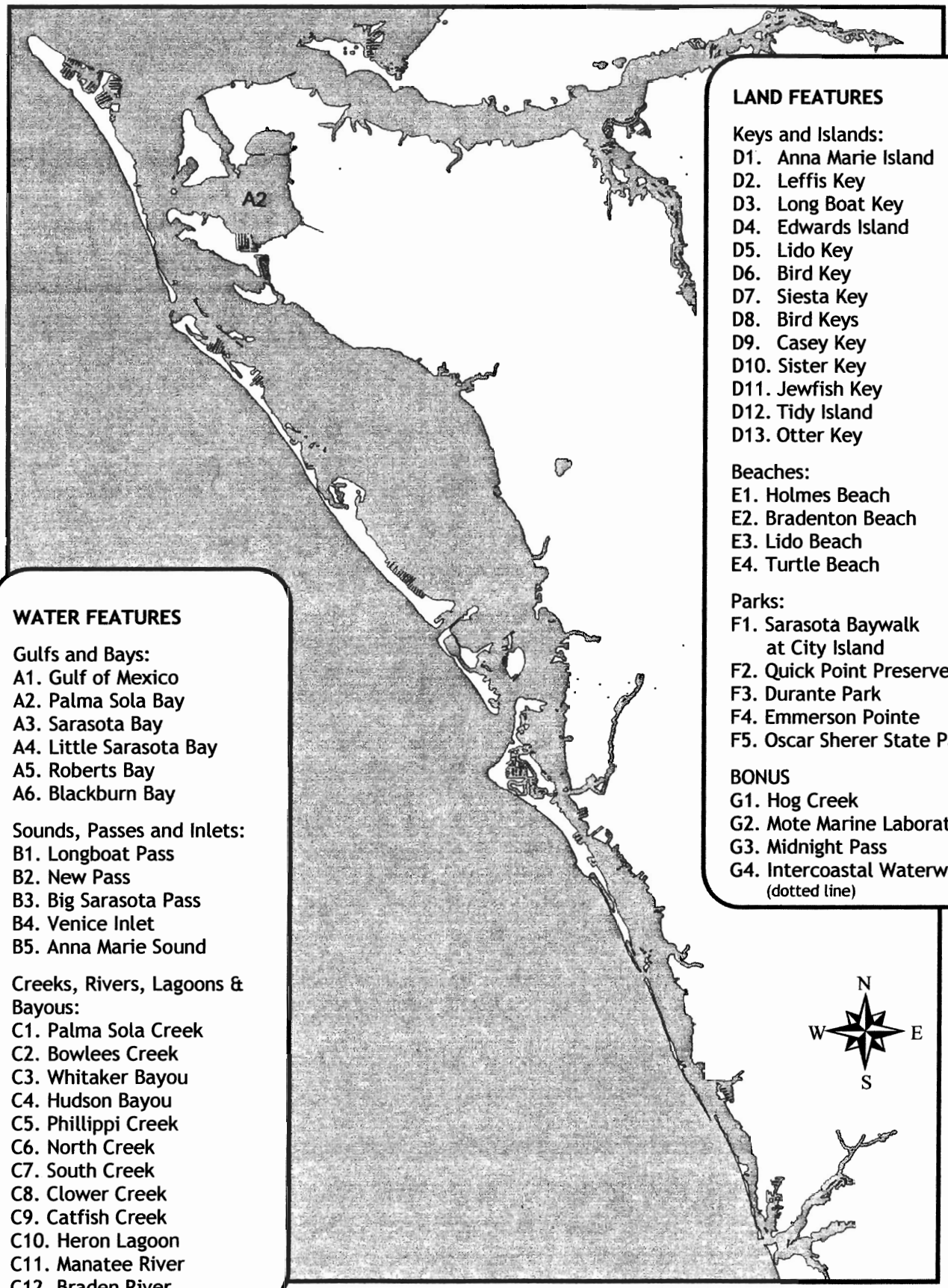
Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

SARASOTA bay COASTAL HABITATS

NAME: _____

DATE: _____

Activity Sheet 1.2.1: Sarasota Bay Map (Student Copy)



LAND FEATURES

Keys and Islands:
D1. Anna Marie Island
D2. Leffis Key
D3. Long Boat Key
D4. Edwards Island
D5. Lido Key
D6. Bird Key
D7. Siesta Key
D8. Bird Keys
D9. Casey Key
D10. Sister Key
D11. Jewfish Key
D12. Tidy Island
D13. Otter Key

Beaches:
E1. Holmes Beach
E2. Bradenton Beach
E3. Lido Beach
E4. Turtle Beach

Parks:
F1. Sarasota Baywalk at City Island
F2. Quick Point Preserve
F3. Durante Park
F4. Emmerson Pointe
F5. Oscar Sherer State Park

BONUS
G1. Hog Creek
G2. Mote Marine Laboratory
G3. Midnight Pass
G4. Intercoastal Waterway (dotted line)

WATER FEATURES

Gulfs and Bays:
A1. Gulf of Mexico
A2. Palma Sola Bay
A3. Sarasota Bay
A4. Little Sarasota Bay
A5. Roberts Bay
A6. Blackburn Bay

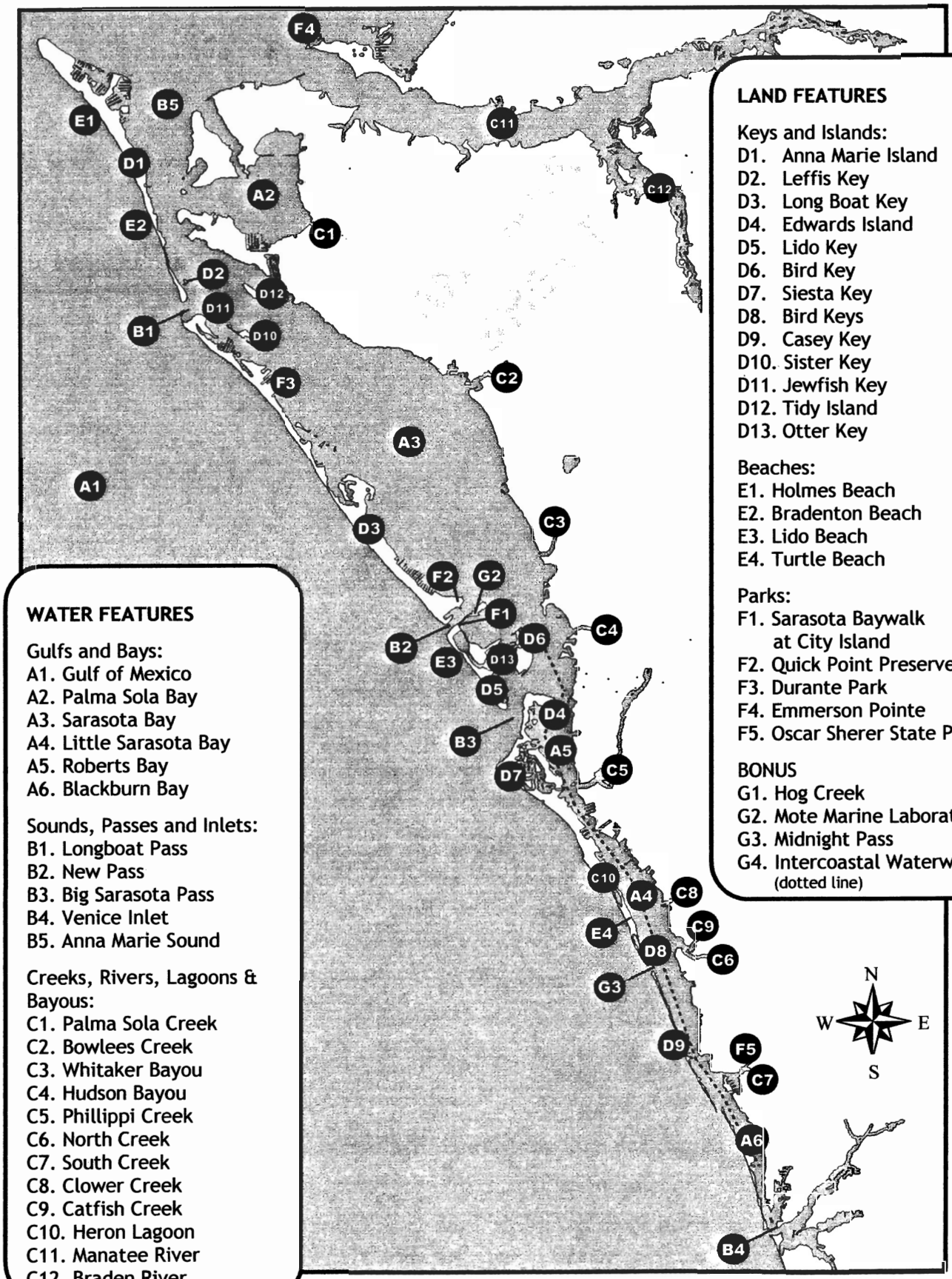
Sounds, Passes and Inlets:
B1. Longboat Pass
B2. New Pass
B3. Big Sarasota Pass
B4. Venice Inlet
B5. Anna Marie Sound

Creeks, Rivers, Lagoons & Bayous:
C1. Palma Sola Creek
C2. Bowlees Creek
C3. Whitaker Bayou
C4. Hudson Bayou
C5. Phillippi Creek
C6. North Creek
C7. South Creek
C8. Clower Creek
C9. Catfish Creek
C10. Heron Lagoon
C11. Manatee River
C12. Braden River

SARASOTA bay COASTAL HABITATS

Lesson 1: Coastal Watersheds

Activity Sheet 1.2.2: Sarasota Bay Map (Teacher Copy)



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C12. Braden River

Habitats are Homes

Habitats are the places where organisms live and find the things they need to survive. This includes food, water, shelter and living space. It can also include things like the right amount of light, temperature or mates. There are many different types and sizes of habitats. For example, the habitat for a bottlenose dolphin may be over 50 square miles of Sarasota Bay, while the habitat of an encrusting tunicate colony may be just a few square inches of a turtle grass blade.

Living on the Edge: Coastal Habitats of Florida

Florida, with its nearly 1200 miles of coastline, has many distinctive habitats along it border with the ocean. These can be found in **natural communities** like maritime forests, beach dunes, salt marshes, mudflats, mangrove swamps, seagrass meadows, oyster bars and coral reefs. The animals, plants and other organisms that live in these areas must constantly adjust to the changing conditions brought about by the tides. This can mean being exposed to both air and water, which affects both salinity and temperature. However, this constant mixing, especially in areas like estuaries, also offers ever-changing opportunities for new food and new places to live and grow. In fact, the brackish water of estuaries are home to an estimated 70 percent of Florida's commercially and recreationally valuable fish and shellfish species during some part of their lives. This makes coastal areas critically important places for a productive environment.

POTABLE QUOTABLES

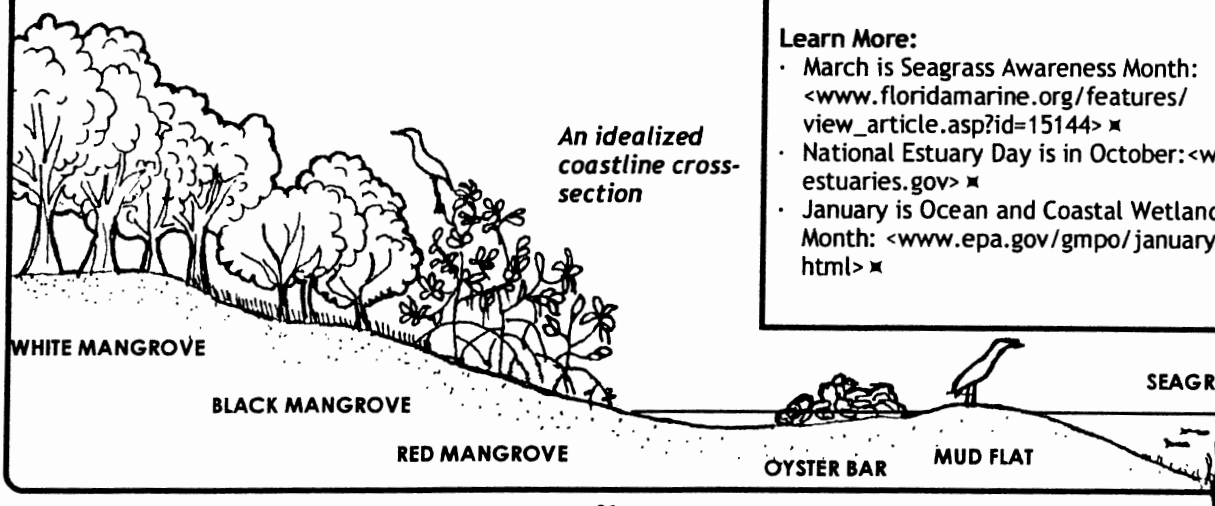
The coast is where the land *littorally* meets the sea.
-Anonymous

HABITAT FAST FACTS

- Intertidal wetlands have decreased by 39% in Sarasota Bay since 1950.
- Seagrass currently covers about 26% of the Bay's 33,000 total bottom acres.
- About 15% (~5,000 acres) of the Bay's bottom has been disturbed to create homesites and boat channels. These areas often do not support diverse aquatic life.
- There are 20 artificial reef sites being implemented by the SBNEP in Sarasota Bay.

Learn More:

- March is Seagrass Awareness Month: <www.floridamarine.org/features/view_article.asp?id=15144>
- National Estuary Day is in October: <www.estuaries.gov>
- January is Ocean and Coastal Wetlands Month: <www.epa.gov/gmpo/january.html>



An idealized coastline cross-section

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Activity 2.1: Habitat Highlights

Grade Level: 4-6

Standards: see Appendix A and B.

Time Required: 50 minutes.

Objective: Students will use reference materials and/or the Internet to describe different coastal habitats found in Florida and the organisms that live there.

Materials:

- Writing materials (Pen or pencil, paper)
- Colored markers or colored pencils
- Books, field guides, reference material about the FL environment
- Maps or Atlases of Sarasota Bay (alternatively, Activity Sheet 1.2.1)
- One (1) copy of Activity Sheet 2.2.1 per student or group
- Internet access (optional)

Background:

WHAT'S THE DIFFERENCE?

The following terms are sometimes used interchangeably, but each one has a different emphasis or meaning.

Habitat: The place where living things find what they need to survive, such as food, shelter, water and living space. Habitats are kind of like one's home address.

Ecosystem: A living community of plants, animals and other living organisms and their relationship with the environment around them. It refers to groups of organisms interacting with each other and with the areas they live in, kind of like one's town or city.

Natural Communities: A natural community is a distinct and recurring group of organisms that are usually found together in the environment. These communities are often labeled according to the kind of plants that are most common in the area (e.g., mangrove swamp, coastal grassland), and can be thought of kind of like a club or neighborhood association.

Suggested Procedures:

1) For this activity, students may work individually or in small cooperative learning groups of two to three. First, ask the students as a class what they think the word **habitat** means, or what ideas they associate with the word. List their ideas on a blackboard or overhead projection. Afterwards, write out the definition formally listed under *What's the Difference?*, and ask them to copy it on their own paper.

2) Tell the students that they are going to focus on habitats associated with the Florida's coast, and give each student or group a copy of Activity Sheet 2.2.1. Go over the descriptions with them as a class.

3) Assign each student or group a different habitat listed on Activity Sheet 2.2. Using field guides, library books and the Internet, have them research the habitat, and expand on the information already provided. In particular, have them try to identify as many different kinds of animals, plants and other organisms that live in their given habitat. Encourage them to be specific (i.e., not just crabs, but blue crabs, fiddler crabs, ghost crabs; not just birds, but osprey, oystercatchers, laughing gulls).

4) Using reference maps and the knowledge about their assigned habitats, let the students try to locate areas around Sarasota Bay that have these kinds of environments. Access to the internet and publications from the Sarasota Bay National Estuary Program may help. If this information is not readily available, allow the students to make their best guess as to their locations, based on their research (i.e., salt marshes around tidal

Activity 2.1: Habitat Highlights (cont'd)

creeks and rivers, mangroves fringing undeveloped shorelines and islands, seagrass meadows along shallow bay bottoms, oyster bars near tidal creeks, artificial reefs in disturbed areas). If they are using a copy of Activity Sheet 1.2, let them draw or color in the habitats on their maps.

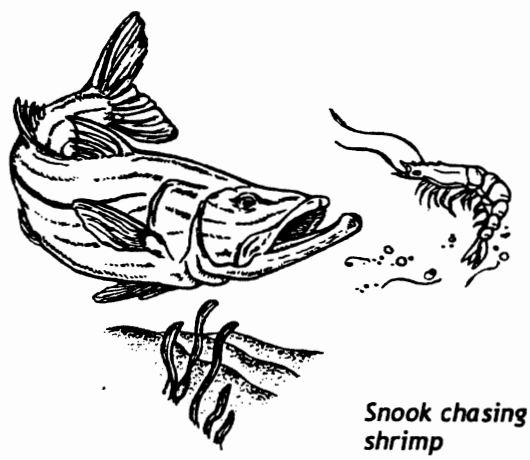
Discussion: What are the characteristics of the highlighted habitats? What other features and creatures of these habitats were the students able to identify? Ask the students if they have ever been to any of these habitats. Encourage them to describe their encounters with the plants and animals that live there.

Extension: Once the students have completed an exhaustive list of organisms, have them re-list them on another sheet of paper. Using the knowledge they have gained about their given habitat and the kinds of organisms that live in them, have the students or groups try to determine which category they think their animals and plants fall into:

a. Organisms that only live in the given habitat and are never found, or never move to anywhere else (permanent residents, 0% of their lives in other places).
b. Organisms that live a majority of their lives in the given habitat, but occasionally grow in, or move in and out of, other places (semi-permanent, about 25% of their lives in other places).
c. Organisms that spend only a portion of their lives in the given habitat, and are often found growing in, or moving freely about other places (temporary or seasonal residents, about 50% of their lives in other places).
d. Organisms that are rarely found in the given habitat, or are only moving through (casual visitors or transients, about 75% or more of their lives in other places).

For animals that move in and out of a given habitat, or spend little time there, have the students research and list at what times those animals are most likely to be seen there. This may mean a certain time of day if the animals are strictly nocturnal or diurnal, or it may mean a certain time of year (especially for migrating birds and manatees). It may also mean only a certain period in the animals life cycle, such as the nesting and hatching of sea turtles on a particular beach.

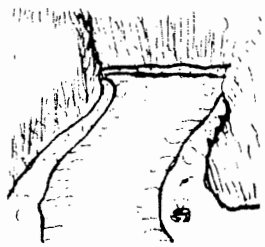
Let the students describe other coastal habitats, such as mudflats, beaches, coral reefs or maritime forests, etc. Alternatively, they could choose inland habitats that may have close hydrologic connections with coastal habitats, such as rivers, freshwater tidal swamps or sinkholes. Have them complete the same exercises listed above.



Snook chasing shrimp

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Activity Sheet 2.1.1: Habitat Highlights



Salt Marsh: Areas between and above the tide lines occupied mostly by nonwoody, salt-tolerant plants; may include various smaller plants (**epiphytes**) and animals (**epifauna**) growing on them. Highly productive areas that stabilize sediment, offer storm protection and cover for wildlife. Plants grow in zones according to their ability to tolerate salt. This habitat is rare in Sarasota Bay, generally occurring around tidal creeks along the mainland shore.

Plants: Black rush (*Juncus* spp.), cordgrass (*Spartina* spp.), leather fern, glasswort, purslane, seaside goldenrod, saltbush, mangroves.

Animals: Raccoons, marsh rabbits, rodents, fish, birds, fiddler crabs, snails, insects, spiders, worms.

Mangrove Swamps: Large areas between and above the tide line that are occupied mostly by woody plants; may include various epiphytes and epifauna growing on them. Mangroves root structures are adapted to the complex and harsh tidal environment and provide sediment stabilization and storm protection. In general, Red Mangroves are most able to tolerate standing in salt water, and are more common below the tide line. Black Mangroves are found further up, between the tide lines, and White Mangroves are most abundant farther away from shore. Leaves, stems and flowers produce litterfall throughout the year, which is a major source of food for this community. Found all along the undeveloped shoreline and barrier islands of Sarasota Bay.

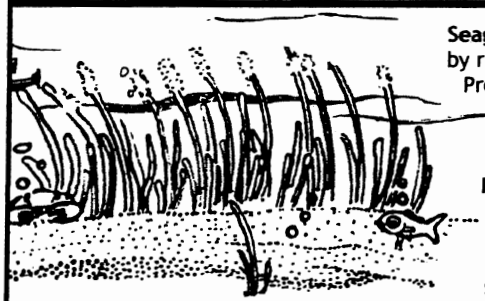
Plants: Black mangrove, buttonwood, red mangrove, and white mangrove.

Animals: Raccoons, mangrove snakes, American crocodiles, fish, oysters, birds, bottlenose dolphins, mangrove tree crabs, snails, insects, spiders, worms.

Oyster Bars: Substantial areas below and above the tide line built up by concentrations of oysters and other mollusks. Provides hard bottom in areas that might otherwise contain soft marine muds and acts as a refuge for small, mobile invertebrates like shrimps and crabs. Oysters are filter feeders that can each potentially filter nearly 10 gallons of seawater every hour. Sporadically found throughout the near shore areas of Sarasota Bay, especially around creeks south of Big Pass.

Plants: Seagrasses sparse, if present. Also microalgae and some macroalgae.

Animals: Oysters, mussels, shell worms, octocorals, sponges, stony corals, crabs, shrimp, wading birds, fish, snails, seastars.

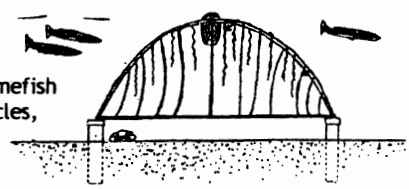


Seagrass Meadows: Expansive areas above or below the tide line, occupied mostly by rooted seagrasses; grasses often have epiphytes and epifauna growing on them. Provide food and shelter for numerous vertebrate and invertebrate species. Mostly located in the nearshore areas of Sarasota Bay, down to a depth of seven feet

Plants: Shoal grass, halophila, widgeon grass, manatee grass and turtle grass. Also microalgae and some macroalgae

Animals: Octocorals, sponges, stony corals, fish, sea turtles, manatees, crabs, snails, worms, seastars, dolphins.

Artificial Reefs: Designed to mimic natural reef systems, these are complex, man-made structures built of pipes, concrete, or other durable materials. They are usually placed in barren or disturbed areas and provide refuge for desirable gamefish species. They also serve as attachment places for settling organisms like barnacles, sponges, corals and algae (epiphytes and epifauna).



What other habitats are found along Florida's coasts? What animals and plants live there?

Activity 2.2: Make It a Habitat

Grade Level: 6-8

Time Required: Two to three 50 minute periods.

Objective: Students will identify the components of a habitat that are essential for many aquatic animals to survive. They will do this by designing an artificial habitat suitable for some aquatic wildlife found along the coasts.

Materials:

- One (1) copy of Activity Sheet 2.2.1
- Art supplies
  - writing materials
  - scissors
  - papier-mache
  - modeling clay
  - gallon jars
  - string
  - cardboard boxes (used to frame the models

Suggested Procedures:

1) Cut out the cards with the animals on Activity Sheet 2.2.1. Feel free to add more animals if necessary.

2) Divide the class into cooperative learning groups of two to four. Have each group draw one card from a hat.

3) Ask each group to design an artificial habitat in which their animal could successfully live. Each group will be expected to consult library reference materials, talk to resource people or conduct Internet research to determine the life requirements of thier creature. In addition, they must investigate and establish the characteristics of the animals's natural habitat.

4) When the research is complete, each group is to design and build a model or small replica of an aquarium habitat which would be suitable for their animal's survival and comfort in captivity. Establish a scale for the exhibits (for example, one inch = five feet for the large animals; actual size for the worms or snails).

5) Once the models are complete, ask each team to report to the rest of the class. Each report should include a description of the basic biological needs of each animal as well as a description of the characteristics of its natural habitat. The students should point out how their models are designed to meet the needs of the animal.

6) Once all the reports are finished, have the students arrange their models in a floorplan for a public aquarium/ museum (optional)

7) Ask the students to summarize the components of habitat that seemed to be necessary for the survival of the aquatic animals they studied. (Food, good water quality, shelter and living space in a suitable arrangement would be the minimum necessary components.)

Discussion:

List the components of suitable habitat that are necessary for most aquatic animals to survive. Pick an aquatic mammal, fish, or other aquatic animal. Describe the biological characteristics of the animal and the kind of habitat requirements it has in order to survive. Compare similarities and differences between this aquatic animal and another aquatic animal. What things, if any, do they both need in order to survive? What things, if any, must be different in their habitats in order for each kind of animal to survive?

Activity 2.2: Make It a Habitat

Background:

Aquariums are artificial habitats. In aquaria, water is a uniquely sensitive part of the habitat and it must serve to do more than quench thirst. The surrounding water must meet specific requirements for different aquatic life forms. Slight changes in salinity, pH, dissolved oxygen and the presence of a wide range of pollutants can spell disaster for certain aquatic organisms.

To successfully house aquatic wildlife in aquariums, careful attention must be paid to the range of conditions that each life form can tolerate. There are also certain physical requirements in terms of the shape and dynamics of the display that must be compatible with each creature. For example, some fish require moving water or currents. Others prefer almost static conditions. Some prefer deep water and others shallow rocky bottoms. The variations are remarkable when one considers designing habitats for microorganisms in pond water versuses the huge habitats for marine mammals.

Concern for the physical requirements of animals must go beyond meeting minimum survival needs. Attention should be given to the animals' comfort, creating conditions as similar to those in their natural habitats as possible.

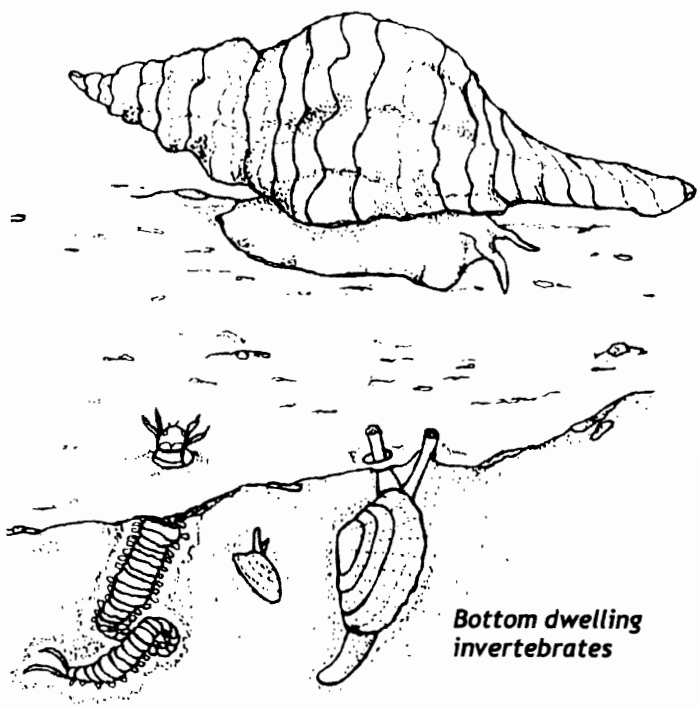
In the growing practices of aquaculture (deliberate cultivation of freshwater organisms) and mariculture (deliberate cultivation of oceanic organisms) much research is conducted regarding habitat requirements. Often natural streams, rivers, lakes and even the ocean are used in these enterprises. Attention to water quality and disease control is just as important in these settings as it is in the confined habitats of an aquarium.

Ethical concerns about the appropriateness or inappropriateness of housing aquatic wildlife in artificial habitats must also be considered. However, this activity is designed simply to address the complex physical needs of aquatic wildlife in order to be able to survive at all under conditions of captivity.

Extensions:

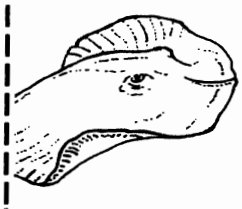
- Visit an aquarium and arrange for a staff person to explain how the aquarium addresses the same basic requirements for animals that the students did.
- Create a balanced aquarium for the classroom.
- Discuss the reasons for and against keeping aquatic wildlife in captivity.

Adapted from: Project WILD. Aquatic Education Activity Guide. 1987.
<www.projectwild.org/materials/sampleaquatic.htm>



Bottom dwelling invertebrates

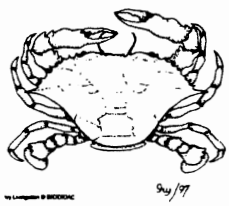
Activity Sheet 2.2.1: Coastal Critter Cards



Name: Atlantic stingray

Diet: Crabs, clams and other bottom dwelling invertebrates.

Notes: Has a venomous barb on its tail that it uses to defend itself



Name: Blue crab

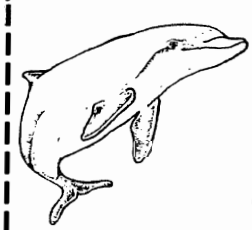
Diet: Dead fish, worms, mollusks, shrimps.

Notes: Strong pinchers for grasping and tearing prey.

Name: Bonnethead shark

Diet: Fish, crustaceans, mollusks.

Notes: Grows to about 3 feet long as an adult.



Name: Bottlenose dolphin

Diet: Fish, squid, shrimp.

Notes: A marine mammal that can use echolocation to find it way and to locate food.

Name: Horseshoe crab

Diet: Small clams, crabs and worms.

Notes: The pointed tail is not venomous. They push themselves upright with it when flipped over.

Name: Mangrove snake

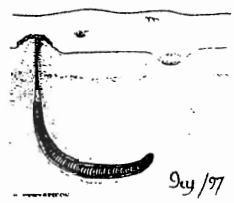
Diet: Small fish, crabs, and shrimp trapped in isolated pools of water by the falling tide.

Notes: Non-venomous.

Name: Oyster

Diet: Filter feeeders that strain plankton and nutrients from the water.

Notes: Attaches together in large groups call beds.



Name: lug worm

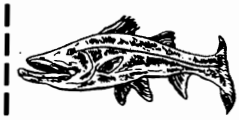
Diet: Sediment feeders, consume detritus.

Notes: Build L-shaped burrows in the sand. A small depression forms above the mouth.

Name: Periwinkle snail

Diet: Algae and detritus

Notes: Usually attached to marsh grasses above the waterline to avoid predators like blue crabs.



Name: snook

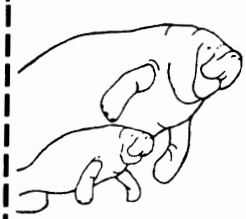
Diet: Smaller fish, shrimp and other crustaceans.

Notes: The black stripe on its side is the lateral line, a sensory organ.

Name: Brittle star

Diet: Scavenges for food from sediment and out of the water column.

Notes: Found in oyster beds and around sponges.



Name: Manatee

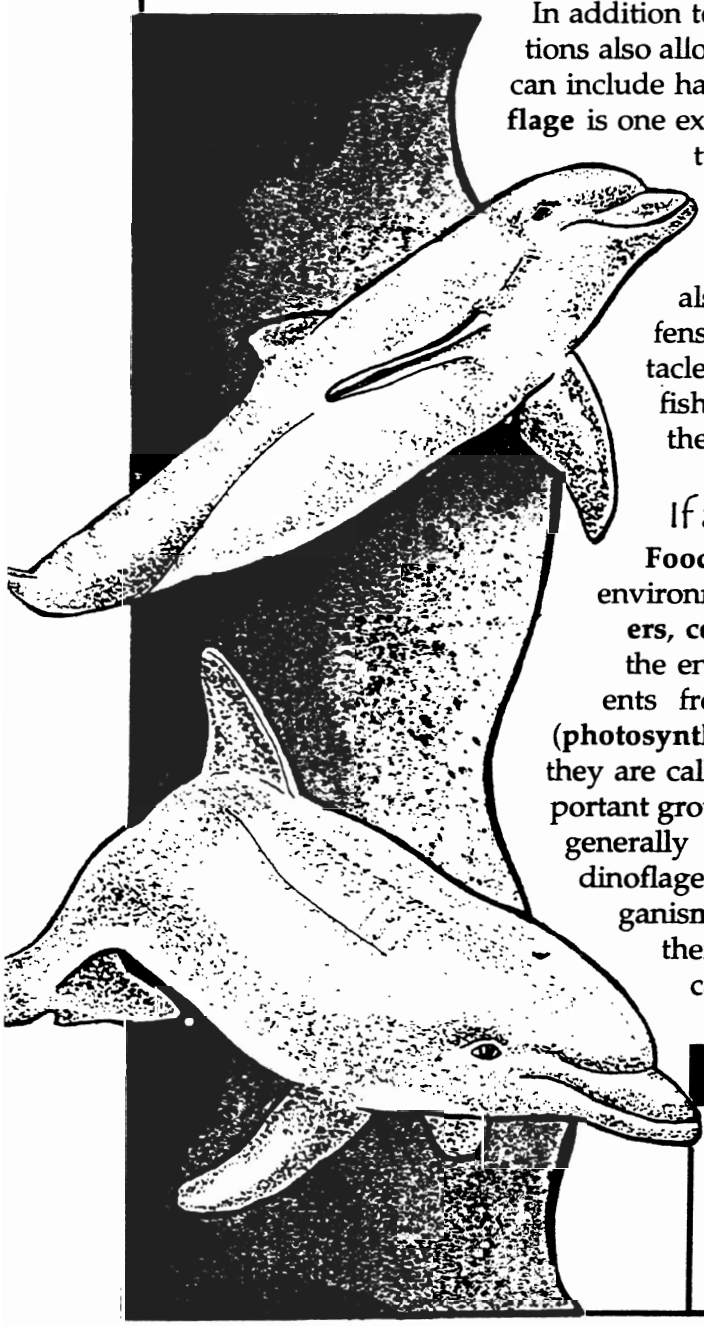
Diet: Aquatic vegetation, including seagrass.

Notes: A marine mammal that is distantly related to elephants.

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Coping with Change

The coastline is an ever changing environment that offers a number of challenges to any thing that tries to lives there. In places like estuaries, organisms must cope with regular fluctuations in salinity and oxygen levels as freshwater from land mixes with salt water from the ocean. Tides can alternately cover creatures with water, and then expose them to drying air. This can lead to quick changes in temperature too. Marine animals cope with these changes in a number of ways. Mobile animals, like fish and crabs, can move to more favorable conditions. Settled animals like oysters and barnacles can shut up their shells, and animals like worms and clams can dig deeper. Many estuary animals are also able to excrete excess salt.



In addition to coping with changes in the environment, adaptations also allow animals to find food and avoid being eaten. This can include having special body shapes and body parts. **Camouflage** is one example that is common among coastal marine creatures. Camouflage allows animals like seahorses and sea hares to blend in to the background by taking on the colors and patterns of the surrounding seagrass. Specialized appendages can also be helpful, both for grabbing food and for defense. Octopods, sea anemones and seastars have tentacles and arms for capturing prey. Stingrays, scorpionfish and sea urchins have sharp spines to protect themselves.

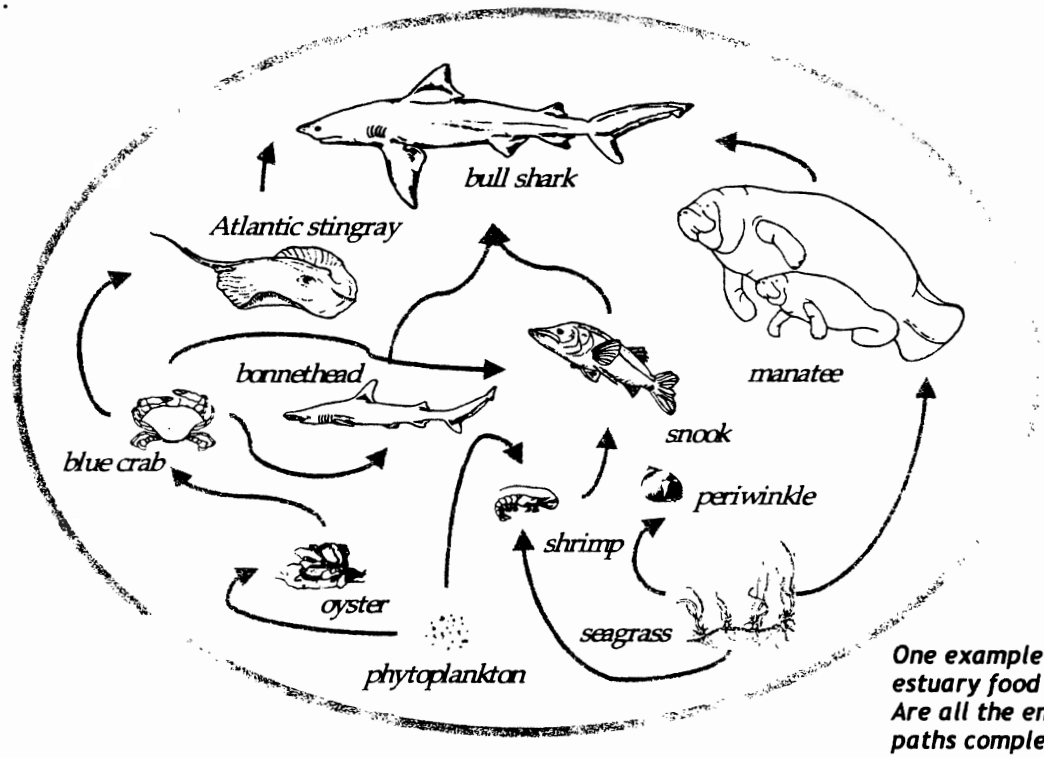
If a Habitat is my Home, What's for Dinner?

Food chains show how energy is cycled through the environment. The simplest food chain consists of **producers, consumers** and **decomposers**. Plants and algae use the energy of the sun, water, carbon dioxide and nutrients from the environment to make their own food (**photosynthesis**). Since these organisms make their own food, they are called producers. In the marine environment, an important group of producers is called phytoplankton. These are generally microscopic photosynthesizing organisms like dinoflagellates that form the base of many food chains. Organisms that do not make their own food, but instead get their energy from eating other plants or animals, are called consumers. Animals that only eat plants are

COASTAL CRITTER FAST FACTS

- There are currently over 130 resident dolphins living in and around Sarasota Bay.
- Over 100 manatees were sighted in Sarasota waters during a single day of surveying.
- Loggerhead sea turtles are the most common species nesting on Sarasota and Manatee beaches.

called **herbivores**. Animals that eat both plants and animals are called **omnivores**. Herbivores and omnivores can be primary consumers, since they are the first organisms in the chain to eat the producers. Animals that eat only other animals are called **carnivores**. They are considered secondary consumers (or tertiary or quaternary, etc., depending on how far removed they are from the primary consumers). Finally, there are organisms that recycle the nutrients by feeding on dead or decaying materials. These are the decomposers. In the marine environment, the decaying material is often available in the form of small bits of plant matter (less than 1cm) called **detritus**. If one expands a food chain by adding more interconnected links, a web of relationships appears. These overlapping links form a **food web**.



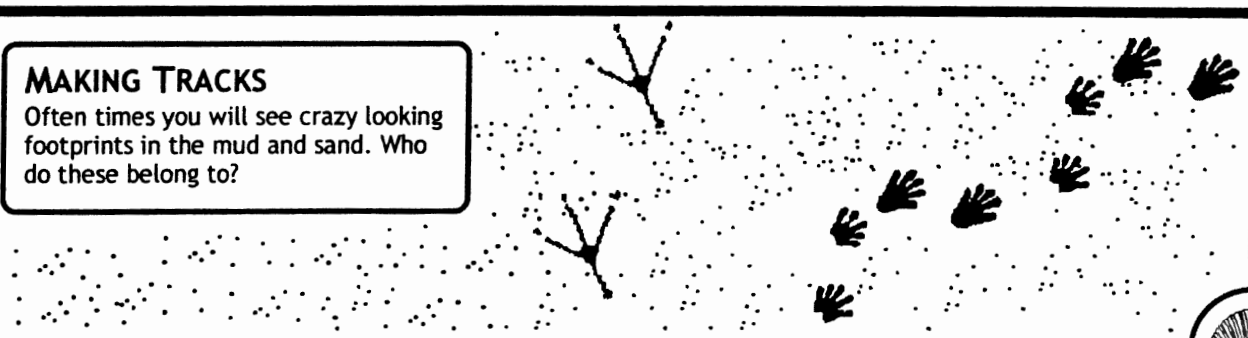
One example of an estuary food web. Are all the energy paths complete?

Waiter, There is Pollution in My Soup

As pollutants move through a watershed, they can come into contact with many different levels of a food chain. When one link of the chain is contaminated, the following links will also be contaminated, but to a greater degree. This is called **bioaccumulation**, which is the increase in the concentration of pollutants as one moves up a food chain. (See Lesson 5 for more information and activities about pollution.)

MAKING TRACKS

Often times you will see crazy looking footprints in the mud and sand. Who do these belong to?



Activity 3.1: A Fish by any Other Name Would Smell

Grade Level: 4-6

Standards: see Appendix A and B.

Time Required: 50 minutes.

Objective: Students will learn about the different varieties of fish that live in coastal waters as well as the adaptations that allow them to survive in these environments.

Materials:
- Writing materials
- Art supplies
- Field guides and other reference material about fish
- Internet access (optional)

Background:

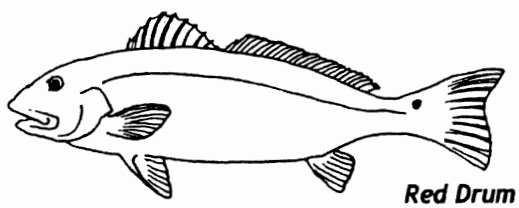
A FISH BY ANY OTHER NAME

The sea can be a strange and scary place to humans, who are more adapt at moving around on the ground than in the water. So when humans first encountered unfamiliar animals from the deep, they would often give them names related to the land animals they already knew about. The following are real fish found along the coasts of the Atlantic Ocean and Gulf of Mexico:

Batfish, Bull Shark, Butterflyfish, Catfish, Cowfish, Dogfish, Frogfish, Goatfish, Hawkfish, Hogfish, Lizardfish, Parrotfish, Porcupine fish, Pigfish, Scorpionfish, Seahorse, Squirrelfish, Toadfish

This is not a complete list. What other marine fish have the names of other animals in their names?

We also name marine fish after familiar objects, like spadefish, guitarfish, needlefish, pipefish and even soapfish. What are some other marine fish named after familiar objects?



Red Drum

Suggested Procedure:

1) Go over the short background exercise above with the entire class. Let the students know that that these are the actual names of fish, even if they have never heard of or seen them before. Allow the students to come up with additional fish names that include other animals or objects in their names. Students may be as imaginative and silly as they want to when proposing new names. Write their suggestions on the board or overhead projection. Note, at the discretion of the teacher, students can name non-fish marine animals like horseshoe crabs, sea hares and sea spiders.

2) Assign each student or group of students one or more of the new, made-up names (depending on how many names were suggested). Using library reference material or the Internet, have the students determine if their made-up fish names actually exist.

   While they are researching their made-up names, encourage students to find and share pictures of the real animals already given in the Background material.

   Some other real possibilities not listed in the background include: alligator fish, coronetfish, crocodile fish, eagle ray, flashlight fish, lionfish, goosefish, pearlfish, rabbitfish, ratfish, seamoth, sea robin, spiderfish, stonefish, tiger shark, trumpetfish, waspfish and wolf eel. Some of these are not Florida fish. Which ones?

   A good resource for finding fish names is Fishbase:
   <www.fishbase.org/search.html>

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

3) The students should now have three groups of fish that they have researched:
   a. The real fish names already given during the background exercise.
   b. Fish names they made-up, but which turned out to actually exist. For these fish, have the students write a short natural history about the animals. Include details such as where they live (freshwater or salt?), what they eat and how common they are. Let the students share this information and any picture they have found with rest of the class.
   c. Fish that they made up, but for which students are unable to find any references for (e.g., eraserfish, doorfish, apefish). Let the students create a short natural history of their imaginary fish. What does it look like? Have them draw a picture. Where does it live? What does it eat?

4) Estuaries have been called the nurseries of the sea, and it is estimated that 70 percent of all Florida's commercially and recreationally valuable fish and shellfish species spend some part of their lives there. Have the student try to identify which of the fish they have just researched spend at least some part of their lives in an estuary. Students should be able to separate their fish into at least two groups: deep water, **oceanic** species and near shore, **coastal** species.

5) Review the concept of adaptations. Ask the students to explain what is meant by the term. Ask the students to list some adaptations of their fish that allow them to survive in their environment.

Extensions:

- Visit MARE's Interactive Fish Builder to learn more about fish adaptations:
  <sv.berkeley.edu/showcase>

- Have the students try to determine which of the fish they researched are found in Sarasota Bay. These resources may be useful:

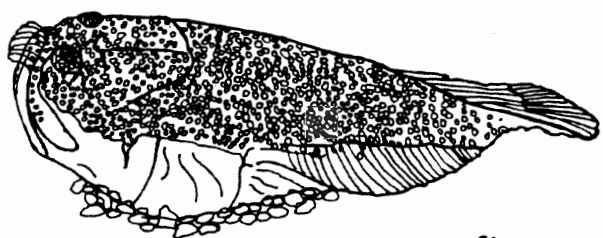
  FWCC Fish Identification Guide
  <www.floridamarine.org/gallery/view_category.asp?catid=1221&subcatid=5131>

  American Littoral Society, SE chapter
  <www.sealitsoc.org/flora_%26_fauna.htm>

- The students will likely find that common names are often applied to very different looking animals. This is because people in different geographical areas often use different local names for the same species of fish. Biologist try to avoid this confusion by giving each species a unique name using a binomial classification system of Latin and Greek words. This would be a good opportunity to introduce a lesson on scientific classification These resources may be useful:

  Science NetLinks:
  Classification of Living Organisms
  <www.sciencenetlinks.com/lessons.cfm?BenchmarkID=5&DocID=87>

  Classifying Critters
  <www.hhmi.org/coolscience/critters/index.html>



Stargazer

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Activity 3.2: Estuary Food Webs

Grade Level: 6-8

Standards: see Appendix A and B.

Time Required: 50 minutes.

Objective: Students will learn about food chains in an estuary.

Materials:
- ❑ Writing materials
- ❑ Art supplies
- ❑ Internet access (optional)

Suggested Procedure:

1) Ask the students what they had for dinner last night. List some of their responses on the black board or overhead projection.

2) Review the concepts of a food chain/ food web in Lesson 4. Ask the students to explain what is meant by each of the bold terms. If these terms are new to your students, write out each word and take time to define and explain each of them, with examples.

3) Go back to the students dinner responses and trace the energy path of some of their responses (e.g., Kyle, human child ← hamburger, cow ← fodder, grass ← sun).

4) Ask the students to think about the kinds of organisms typically found in a Florida estuary. Working individually or in groups, have them write down 9 or more possibilities, making sure they include the following details:
   - At least 3 producers (e.g., phytoplankton, cordgrass, seagrass, mangroves).
     - How the producers get their energy (most likely from the sun).
     - Where they grow in the estuary
     - What feeds on each of them.
     - List 2 adaptations that makes each one well suited to its enviroment.
   - 3 primary consumers (e.g., sea hare, manatee, mullet).
     - How they get their energy (herbivore or omnivore).
     - Where they live in the estuary.
     - What feeds on each of them.
     - List 2 adaptations that makes each one well suited to its enviroment.
   - 2 secondary consumers (e.g., snapper, osprey)
     - How they get their energy (omnivore or carnivore).
     - Where they live in the estuary.
     - What feeds on each of them.
     - List 2 adaptations that makes each one well suited to its enviroment.
   - 1 tertiary consumer (e.g., barracuda, shark).
     - How they get their energy (omnivore or carnivore).
     - Where they live in the estuary.
     - What feeds on each of them, if anything.
     - List 2 adaptations that makes it well suited to its enviroment.

5) Have the students create a food web of a Florida estuary using the organisms from Step 4.
   - Have them name each organism and draw a picture.
   - Include arrows correctly showing the energy flow from each organism.
   - Correctly label each level as either producers, primary consumers, secondary consumers, or tertiary consumers.

Extensions: Review the concepts of bioaccumulation of pollutants in a food chain. Have the students explore the sources of pollution in Sarasota Bay and how it affects the organisms that live there.

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Activity Sheet 3.2.1: Coastal Creature Feature

VERTEBRATES—with a backbone

MAMMALS
Name: Raccoon (*Procyon lotor*)
Description: Raccoons are medium-sized mammals that have black masks and ringed tails. Their fur is grayish brown or sometimes reddish black. Drab coloration allows them to blend into their environment. Raccoons in Florida usually do not get bigger than eight pounds.
Diet: Omnivore; feeds on a varied diet including crustaceans, bird eggs, fruits and nuts.
Adaptations: Sensitive, hand-like paws that are used to feel for food along the edge of creeks. Claws for climbing trees.
Learn more: <www.floridawildlifemagazine.com/species/racoon.htm>

BIRDS
Name: Brown pelican (*Pelecanus occidentalis*)
Description: Large dark seabirds with a whitish head and gray-brown body. It plunges from great heights into the water to capture its prey.
Diet: Carnivore; fish and other small swimming marine animals.
Adaptations: Air sacs just beneath the skin to cushion the blow from diving. Pouch-like beak used to capture fish.
Learn more: <www.floridaconservation.org/viewing/species/brwpelican.htm>

REPTILES
Name: Diamondback terrapin (*Malaclemys terrapin*)
Description: Small turtles that live in the brackish water of saltmarshes along the Atlantic and Gulf of Mexico. Usually have grayish skin with dark spots or markings, however the Florida sub-species is often slate-black in color. In the past, these animals were used to make turtle soup.
Diet: Carnivore; eats crustaceans and other small marine animals.
Adaptations: Hard bony shell protects them from predators. Able to tolerate brackish water.
Learn more: <www.fnai.org/FieldGuide/pdf/Malaclemys_terrapin.PDF>

FISH
Name: Dwarf Seahorse (*Hippocampus zosterae*)
Description: Very small seahorse species, rarely exceeding one inch in length. Very common in the waters of SW Florida, found only in shallow seagrass. Spots all over its body, and a short snout.
Diet: Carnivore; small marine invertebrates, especially crustaceans (copepods)
Adaptations: Prehensile tail can wrap around seagrass blades. Camouflage.

BONUS QUESTION: Why are amphibians like frogs and toads usually rare in marine environments?

INVERTEBRATES—without a backbone

PORIFERANS (POR-IF-ERANS, SPONGES)
Name: Boring sponge (*Cliona* spp.)
Description: A colorful group of sponges, usually bright red, yellow and orange. Living sponges have jelly-like bodies made up of specialized cells, supported by a skeleton of tough fibers (called spongin) and small, hard splinter-like structures (called spicules). Boring sponges make their

PORIFERANS (CONT'D)
homes by boring holes into objects made up of calcium carbonate, like limestone, corals, clam shells (but not pineapples!). If you find a shell on the beach with small holes in it, it may have been caused by a boring sponge.
Diet: Filter feeder; draws in small bits of food floating in the sea water through pores (called ostia)
Adaptations: Bioerosion, the ability to bore holes into hard objects made of calcium carbonate.
Learn more: <www.ucmp.berkeley.edu/porifera/poriferamm.html>

CNIDARIANS (NYE-DARE-IANS, JELLYFISH AND ANEMONES)
Name: Cloak anemone (*Calliactis tricolor*)
Description: Small anemones, usually pale brown, though sometimes dark orange or red. Often found attached to the shells of large hermit crabs. It is thought that the stinging cells of the anemone protect the hermit crab, or offers camouflage. Hermit crabs are messy eaters, and the anemone often gets little bits of food the crab throws away.
Diet: Carnivore; eats plankton and other small animals.
Adaptations: Stinging cells, symbiotic relationship with hermit crabs.

CRUSTACEANS (KRUS-TAY-SHUNS, CRABS AND LOBSTERS)
Name: Brown shrimp (*Penaeus aztecus*)
Description: A brown to olive shrimp with long antennae. Grows up to 7 inches in length. This is one of the edible species.
Diet: Omnivore, eats detritus (small bits of plant matter), plankton and marine worms.
Adaptations: Burrows up to 2 inches under the bottom to escape predators during the day; active at night.
Learn more: <www.sms.si.edu/IRLSpec/Penaeu_duorar.htm>

GASTROPODS (GAS-TRO-PODS, SNAILS AND SLUGS)
Name: Ragged sea hare (*Bursatella* spp.)
Description: Large sea slugs that kind of look like rabbits when viewed head on. These are often found in seagrass meadows, where their greenish color and ragged appearance help them blend in with their surroundings. If you find one of these, be careful, or they might drip purple ink all over you.
Diet: Herbivore, feeds in seagrass meadows.
Adaptations: Camouflage; secretes purple ink that repels predators.
Learn more: <www.seaslugforum.net/bursleac.htm>

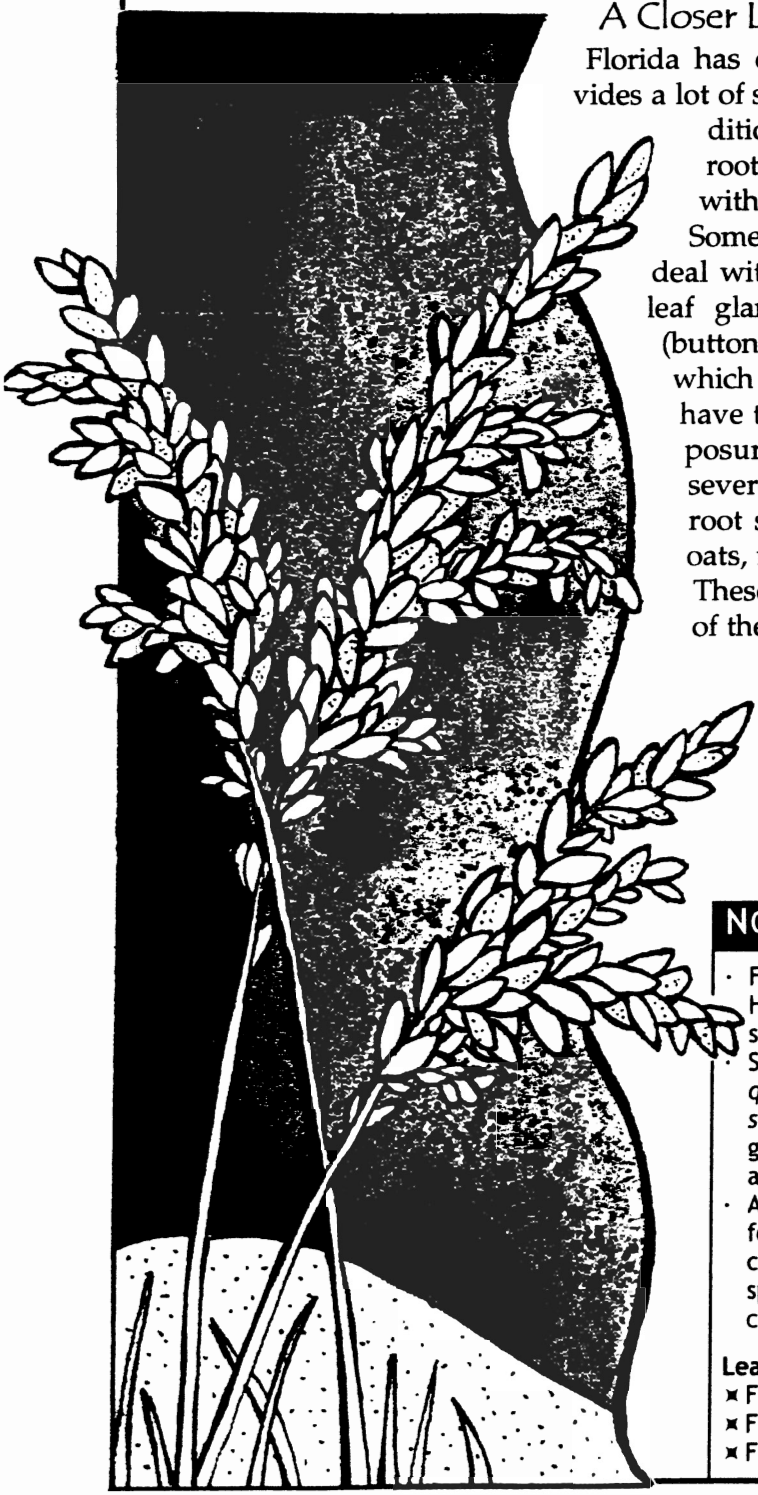
ECHINODERMS (E-KINO-DERMS, SEASTARS AND THEIR KIN)
Name: Sand dollar (*Mellita quinquiesperforata*)
Description: Living sand dollars are usually light brown or tan (dead ones are white) with a shell covered with thin short spines. There are five slots in this species. They are found in shallow, sandy areas.
Diet: Detritus and filter feeders.
Adaptations: Hard shell (called a test) and spines make them difficult for predators to eat. Able to burrow in the sand to find food.

HEY, THAT'S WEIRD: Acorn worms are marine animals that are classified somewhere in-between vertebrates and invertebrates. They are in the phylum Hemichordata (him-ee-kor-dah-ta, Greek, "half-chordates"); they have a nerve cord similar to vertebrates, but no hard spine.

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Florida: Land of Flowers

Florida is the third most botanically diverse state in the US, with over 3,800 different kinds of ferns and seed plant species. Part of the variety is due to the state's humid, semitropical climate and its peninsular shape. This allows both temperate and tropical species to grow here. However, about one third of the plant species in Florida are not native.



A Closer Look: Native Coastal Plants

Florida has over 8000 miles of tidal coastline. This provides a lot of space for plants to grow, but the physical conditions can make it difficult for them to get a root-hold. In order to survive, they must cope with both salty water and frequent severe storms. Some species, like the white and black mangroves, deal with excess salt by excreting it through special leaf glands. Others can store salt in their leaves (buttonwoods) or seeds (red mangrove propagules), which are later dropped. Coastal plants also usually have thick, waxy leaves, which helps limit their exposure directly to salt water or spray. To deal with severe storms, coastal plants develop extensive root systems to help hold them in place (e.g., sea oats, red mangrove prop roots, seagrass rhizomes). These plants are often protected by laws because of the value they have in stabilizing the shoreline.

Learn more:

- Dune Plants: <www.floridaplants.com/nature_of_florida.htm>
- Green Thumb at the Coast: <www.dep.state.fl.us/lands/invaspec/2ndlevpgs/pdfs%20for%20pubs/Circular%2021.pdf>

NON-NATIVE PLANT FAST FACTS

- Florida has over 3,800 kinds of ferns and seed plants. However, it is estimated that nearly one-third of those species are non-native.
- Since 1986, partial control of melaleuca (*Melaleuca quinquenervia*) and Australian pine (*Casuarina equisetifolia*) in the East Everglades, adjacent to Everglades National Park, has required 14,000 labor hours and $546,000 in herbicide and helicopter costs.
- At least 45% of the invasive non-native plant species found in Florida were imported for ornamental or agricultural reasons, and 39% of the worst invasive plant species are still commercially available for sale and continue to spread.

Learn more:

- Free mural: <aquat1.ifas.ufl.edu/mural.html>
- Florida Exotic Pest Plants: <www.fleppc.org>
- Florida Native Plants: <www.fnai.org>

Stranglers in Paradise

About 1200 non-native plant species have been introduced into Florida. Sometimes these non-natives are brought in intentionally, either for agricultural (e.g., melaleuca, para grass) or ornamental purposes (e.g., brazilian pepper, carrotwoord). Other times they arrive accidentally, as hitchhikers in freight (e.g., cogon grass) or on wildlife (e.g., West Indian marsh grass by birds).

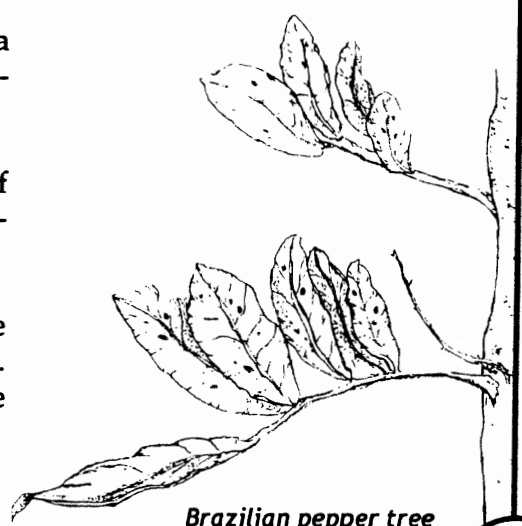
By definition, non-native plants did not develop in their new surroundings. Consequently, they do not face the same competition as they would have in their home range. The animals and diseases that would normally consume them are not around, and the plants that usually compete against them are not present. This often puts non-native plants at an advantage over native plants. Some non-native plants can even invade and displace native plants, which disrupts entire ecosystems. For example, melaluca forms very dense stands of tall trees in areas of the Everglades that were once covered by low growing saw grass. The animals and plants that were adapted to living in the saw grass marshes can not live in the shade of thick groves of melaluca. It can be very difficult and expensive to control the growth of invasive, non-native plants.

What's the Difference?

The following terms are sometimes used interchangeably, but each one has a slightly different meaning or emphasis.

- **Non-native:** Plants that have been introduced to an area outside its native range, either purposefully or accidentally.
- **Exotic:** Often refers to non-native plants that are purposely cultivated for ornamental or landscape reasons. Used as a synonym for non-native.
- **Invasive:** Refers to plants that are capable of *invading* an established ecosystem and disrupting it. Can apply to both native and non-native species. Plants that are both non-native and invasive cause the most trouble.
- **Alien:** Refers to species that are out of place in a given enviroment. Used as a synonym for non-native.
- **Weed:** Defined by the Weed Science Society of America as "a plant growing where it is not desired." Can apply to native and non-native plants.

Here are some other terms used to describe non-native species: **introduced, non-indigenous, transplants.** How are these terms similar or different than those listed above?



Brazilian pepper tree

Choking the Coasts

Two of Florida's worst non-native plants are Australian pine and Brazilian pepper:

Name: Australian pine (*Casuarina glauca*)

Aliases: ironwood, beefwood, she oak and horsetail tree. See also, *Casuarina equisetifolia.*

Origin: Australia

Description: These trees looks like pines (conifers), but are actually flowering plants (angiosperms). The dense, green "needles" of this tree are really branchlets with small, scale-like leaves. It can grow to 70 feet and has woody cone-like fruit clusters containing small, winged nutlets. Their seeds are dispersed by water, wind and birds.

Introduction and Impact: These plants were first introduced to Florida in the early 1900s for use as windbreaks and shade trees. They are somewhat salt tolerant and able to colonized marginal areas (disturbed areas, dunes, beaches) because of associative nitrogen fixing bacteria in their roots. However, unlike native coastal plants, Australian pines do not develop deep, stabilizing root systems. This, along with their large crowns, make them prone to blowing over during storms. When this happens, they take large amounts of soil along with them, exposing the shoreline to increased erosion. They also produce a dense leaf litter which smothers most herbaceous plants below them and, along with their roots, interferes with the nesting of sea turtles.

Control: No biological controls are currently available. Small growths can be removed by hand. Larger infestations can be controlled by cutting down the trees and applying herbicide to the stumps. Raking and removal of litter should be done whenever possible.

Name: Brazilian Pepper (*Schinus terebinthifolius*)

Aliases: Florida holly, Christmas berry, pepper tree

Origin: Brazil, Argentina, Paraguay

Description: Brazilian peppers are evergreen shrubs that can grow to 45 feet from multiple trunks. Their thin branches arch and intertwine, forming dense clumps. Their leaves are aromatic (smell like turpentine), and their sap can be irritating to some allergic individuals. They develop bright red berry clusters in the fall and winter. Seeds are dispersed by wildlife (particularly migrating robins) and by people who use the fruiting branches for decoration.

Impact: This species was imported in the mid-1800s as an ornamental plant. It quickly spread from cultivation, growing into disturbed areas, along roadsides, pastures, hammocks and even mangrove forests. They form dense thickets, called monocultures, where only Brazilian pepper can grow. This prevents the growth of native plants, and great reduces the habitat for wildlife.

Control: Many native insects will feed on the leaves and fruit of Brazilian pepper. However, none of them are known to be specific to this plant alone. Small trees can be removed by hand cutting. Larger infestations can be controlled by cutting down the trees and applying herbicide to the stumps. Native vegetation should be planted in recently disturbed areas to prevent Brazilian pepper from spreading. Florida has listed Brazilian peppers on its prohibited plant list. It is illegal to cultivate, sell or transport them.

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Activity 4.1: Alien Inquisition

Grade Level: 4-6

Time Required: 50 minutes.

Objective: Students will learn about native and non-native plants.

Materials:
- Writing materials
- Field guides and reference material on native and non-native plants:
  Identification and Biology of Non-Native Plants in Florida's Natural Areas, Editors : K.A. Langeland and K. Craddock Burks, <www.fleppc.org/ID_book.htm>
- One (1) copy of Activity Sheet 4.1.1, for each student or group of students.
- Internet access (optional, but highly recommended)
  Center for Aquatic and Invasive Plants, <plants.ifas.ufl.edu/photocat.html>

Suggested Procedures:

1) As a class, ask the students to give the common names of some plants that they have seen and are familiar with. This can include anything from house plants and garden vegetables, to trees in a yard. Encourage them to describe the plants to their classmates and include details about where they specifically saw it growing.

2) Next, go over the definition of native and non-native plants. Give examples of each using reference materials. Ask the students if they know whether any of the plants they just described in Step 1 are native or non-native. If they are uncertain, have them use reference resources to find out.

3) Explain to students the benefits of native plants and the problems caused by the introduction of non-native plants. They should understand how these plants are introduced into the environment and how resource managers attempt to control their growth.

4) Have the student complete Activity Sheet 4.1.1. Review the correct answers with the class after the students complete their sheets.

Extensions:
- If time allows, arrange to take the students on a walking tour of the school campus. Have the students try to find examples of non-native plants growing on the school grounds. These are often found in landscape beddings and along fence lines and edge areas. Remind students not to pick up or remove vegetation, even if it is non-native, without adult permission and supervision. Many plants contain irritating compounds that produce allergic reactions, especially Brazilian Pepper.
- Invite an extension officer or resource manager to your class to speak about native plant communities in your area and how they control non-native species. Some of the control methods can be quite dramatic, including the use of controlled burns, aerial spraying and the use of heavy machinery.

Sarasota & Manatee Cooperative Extension
<www.ifas.ufl.edu/extension/index.htm>

Sarasota County Resource Protection Program
(941) 861-6113
<www.co.sarasota.fl.us/resource_protection/default.asp>

Florida House Learning Center, (941) 316-1203
<sarasota.extension.ufl.edu/FHLC/flahouse.html>

NAME: _____

DATE: _____

Activity Sheet 4.1.1: Alien Inquisition (Student Copy)

1) What is a non-native plant? Give three examples of a non-native plant found in Florida.

2) What conditions allow non-native species to grow?

3) What are two other words used to describe non-native species?

4) What are two ways non-natives get into our yards?

5) What are some methods resource managers use to control non-native plants?

6) Define invasive species.

BONUS: Australian pine and Brazilian pepper trees release allelopathic compounds. Look up the word **allelopathy**, and describe how allelopathic compounds impact native plants.

What You Can Do about Non-native Aquatic Plants:

- Boat trailers are one of the major sources of moving exotic aquatic weeds from one water body to the next. Before leaving a boat ramp, carefully inspect the trailer and boat for aquatic weeds. Many plant species can grow back from even tiny fragments, thereby infesting new bodies of water.
- Never empty the contents of your home aquarium into the wild. Many aquarium plants are imported from around the world and could become a nuisance weed in Florida's waters.
- Report new infestations of pest species such as water-hyacinth and hydrilla to the Florida Department of Environmental Protection.

Learn more: <www.dep.state.fl.us/lands/invaspec/2ndlevpgs/faq.htm>

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Activity Sheet 4.1.2: Alien Inquisition (Teacher Copy)

1) What is a non-native plant? Give three examples of a non-native plant found in Florida.

Non-native plants are ones that have been introduced to an area outside their home range, either purposefully or accidentally. Some example of non-native plants in Florida are melaluca (punk tree), Brazilian pepper (Florida holly), Australian pine and carrotwood.

2) What conditions allow non-native species to grow?

Possible answers include: lack of the natural animals and diseases that would normally consume them; lack of the plants that they normally compete against in their home range; disturbance of natural habitats gives non-native a root-hold.

3) What are two other words used to describe non-native species?

Possible answers include: introduced, non-indigenous, transplant, exotic, alien.

4) What are two ways non-native plants get into our yards?

Possible answers include: intentionally placed in the ground as landscape or ornamental plantings; accidentally mixed in with compost or soil; hitchikers in the pots of other desirable plants; brought in by wildlife (usually bird droppings); blown in by wind; spread from next door lots.

5) What are some methods resource managers use to control non-native plants?

Possible answers include: cutting; herbicide; prescribed fire; biological controls.

6) Define invasive species.

Refers to plants (or animals) that are capable of invading an established ecosystem and disrupting it. Can apply to both native and non-native species. Plants that are both non-native and invasive cause the most trouble.

BONUS: Australian pine and Brazilian pepper trees release allelopathic compounds. Look up the word **allelopathy**, and describe how allelopathic compounds impact native plants.

Allelopathy (al-lee-lop-ah-thee) is a chemical process that some plants use to keep other plants out of its space. Allelopathic plants can put these compounds into the soil through their roots or leaf litter. When non-native plants like Australian pine and Brazilian pepper become established in an area, they can keep other plants from growing there by releasing allelopathic compounds.

Learn more: Back Off! How Plants Guard Their "Personal Space" with Poisons
<www.units.muohio.edu/dragonfly/itc/INDEX.HTMLx>

Activity 4.2: Florida Yards and Neighborhoods

Grade Level: 6-8

Standards: see Appendix A and B.

Time Required: Two to three 50 minute periods.

Objective: Students will learn about the Florida Yards and Neighborhood Program.

Materials:
- ❑ Writing materials
- ❑ Graph paper
- ❑ Activity Sheet 4.2.1
- ❑ Internet access (highly recommended)

Suggested Procedures:

1) Review the concepts in Lesson 5 and on the following Internet sites:
   - Florida Yard and Neighborhoods Program <hort.ufl.edu/fyn/hand.htm>
   - Florida Yardstick Workbook <hort.ufl.edu/fyn/table-of-contents.htm>

2) Student will need to complete Activity Sheet 4.2.
   - Students should take this sheet home and complete it with a supervising adult.
   - Students with a yard at home may complete the survey individually.
   - Students without a yard may be assigned to a cooperative learning group that includes one or more students with a yard. Students without a yard will need to copy the survey information from students with a yard. Alternatively, students without yards at home may ask a relative or neighbor with a yard to help them complete the survey. Students that live in apartments may be able to ask the manager or groundskeeper for help. If none of these options are available, consider allowing them to use the school grounds to complete the information.

3) After all the students complete their surveys, have them draw a diagram of their surveyed yard. Try to have the students accurately scale their diagram using graph paper. Have them include the following:
   - Location and names of trees, plants and plant beds.
   - Location of drainage features (downspouts, ponds, ditches, creeks, gutters) and arrows to show approximate direction of flow.
   - If they have a sprinkler system, have them indicate where the sprinklers are located and the area that they cover.
   - Describe and/or draw pictures of any wildlife that uses their surveyed yard.

4) Ask the students to think about ways their surveyed yard could be improved, based on the recommendations of the Florida Yards and Neighborhoods Handbook. Have them list these ideas with their diagram. Alternatively, have them design a new landscape design using steps listed in the Florida Yards and Neighborhoods Handbook.

5) Have the students answer the following questions:
   - What benefits do native plants offer for landscaping?
   - How do plants help with controlling stormwater runoff and pollution?

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

SARASOTA bay COASTAL HABITATS

NAME: _____

DATE: _____

Activity Sheet 4.2.1: Homeowner Survey

Students: Take this survey home and complete the information with the help of a supervising adult. If you are not sure how to answer these questions, ask your teacher for help. More information is also available from the **FLORIDA YARDS AND NEIGHBORHOODS** website: <hort.ufl.edu/fyn/hand.htm>.

The information in this survey will only be used for class. To complete an offical **HOMEOWNER SURVEY**, visit the University of Florida's website: <hort.ufl.edu/fyn/quest.pdf>

GENERAL INFO

1. What is the size of the property or lot that you maintain as lawn or landscape? Check the answer that best fits your situation.

___ About 1/8 acre (7,500 Sq. Ft. or less)
___ About 1/4 acre (7,501-12,500 Sq. Ft.)
___ About 1/2 acre (12,501-30,000 Sq. Ft.)
___ About 1 acre (30,001-50,000 Sq. Ft.)
___ Over 1 acre (specify) _____

2. About what percent of your landscaped area is lawn (turfgrass)?

___ 0% (no lawn)
___ Less than 25% 26 to 50%
___ 51 to 75% 76 to 100%

SITE ANALYSIS, PLANTING AND LANDSCAPE DESIGN

3. Please indicate whether you use any of the following practices:

Plants are chosen based on site conditions (soil pH, soil drainage, sun, shade, salt, etc.).
___ Yes ___ No ___ Don't know

Plants are grouped into beds by water needs.
___ Yes ___ No ___ Don't know

Trees and shrubs are planted with the top of the root ball even with or slightly higher than the soil surface.
___ Yes ___ No ___ Don't know

Western and eastern walls of your home are shaded.
___ Yes ___ No ___ Don't know

Air conditioner and surrounding area are shaded without blocking air flow.
___ Yes ___ No ___ Don't know

Low-maintenance areas are included in the landscape (natural areas, ground covers and mulch areas).
___ Yes ___ No ___ Don't know

STORMWATER RUN-OFF

4. Please indicate whether you use any of the following practices to keep stormwater on site.

Downspouts drain onto the lawn, landscape beds, or containment areas where rain can soak into the soil.
___ Yes ___ No ___ Don't know

Mulch, bricks, gravel or other porous surface are used on walkways, patios and driveways.
___ Yes ___ No ___ Don't know

A rain barrel or cistern collects rainwater for irrigating plants.
___ Yes ___ No ___ Don't know

Low areas in the landscape catch and filter stormwater.
___ Yes ___ No ___ Don't know

IRRIGATION

5. How are your lawn and landscape beds watered? Check all that apply:

Lawn	Beds	
___	___	Rainfall only.
___	___	Permanent sprinkler system.
___	___	Drip, trickle, microsprayers, soaker hoses or other low volume system.
___	___	Garden hose and sprinkler or hand-held nozzle.

6. Please indicate whether you use any of the following irrigation practices.

Plant beds are watered separately from lawn.
___ Yes ___ No ___ Don't know

1/2 to 3/4 inch of water is applied per irrigation.
___ Yes ___ No ___ Don't know

Adjust watering according to rainfall and season.
___ Yes ___ No ___ Don't know

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Activity Sheet 4.2.1: Homeowner Survey (cont'd)

FERTILIZATION

7. Fertilizer is applied in your lawn or landscape by:
___ No one (fertilizer never applied; go to Question #9).
___ You or a member of the household.
___ A lawn service or commercial maintenance company.

8. Please indicate whether you or your lawn care service use any of the following practices:
Fertilizers with slow release components are used.
___ Yes ___ No ___ Don't know
Fertilizer is applied at rates of 1 pound or less of **actual** nitrogen per 1000 square feet.
___ Yes ___ No ___ Don't know
Iron sulfate is used on lawns instead of fertilizer in summer.
___ Yes ___ No ___ Don't know

PEST MANAGEMENT

9. Pests are controlled in the lawn or landscape by:
___ No one controls pests (go to #11).
___ You or a member of the household.
___ A lawn service or commercial maintenance company.

10. Please indicate whether you or your lawn care service use any of the following practices.
The lawn and/or landscape plants are routinely checked for pest problems.
___ Yes ___ No ___ Don't know
Pesticides are applied only when a pest problem is confirmed.
___ Yes ___ No ___ Don't know
Only infested plant(s) or lawn area(s) are spot-treated.
___ Yes ___ No ___ Don't know
Avoid practices which encourage pests (i.e. mowing too low, excessive watering or fertilizing, improper pruning).
___ Yes ___ No ___ Don't know
If a pesticide is needed, the product (i.e. soaps, oils, etc.) with the least harmful impact on the environment is chosen.
___ Yes ___ No ___ Don't know

MOWING, MULCHING AND RECYCLING

11. Does a lawn care service or maintenance company mow your lawn and/or care for your landscape?
___ All the time ___ Sometimes ___ Never

12. What type(s) of lawn grass do you have?
___ Dwarf St. Augustine ___ Centipede
___ Bahia ___ St. Augustine ___ Bermuda
___ Zoysia ___ Don't know _____ Other

13. At what height do you or your lawn care service mow the lawn?
___ Under 1 ½ inches ___ 1 ½ - < 2 inches
___ 2 - 3 inches ___ Over 3 inches
___ Don't know

14. Please indicate whether you or your lawn care service use any of the following practices.
Mulch is applied 2 to 3 inches deep in beds around trees and shrubs.
___ Yes ___ No ___ Don't know
Yard trimmings, leaves, pruning clippings, grass clippings, etc. are used on site.
___ Yes ___ No ___ Don't know
Alternatives such as eucalyptus, melaleuca, or recycled mulches are used.
___ Yes ___ No ___ Don't know
Grass clippings are left on lawn.
___ Yes ___ No ___ Don't know

WILDLIFE

15. Please indicate whether you use any of the following practices.
Use plants in landscape which provide food for wildlife.
___ Yes ___ No ___ Don't know
Use plants in landscape which provide cover or nesting sites for birds.
___ Yes ___ No ___ Don't know
Provide sources of water for wildlife.
___ Yes ___ No ___ Don't know

ON THE WATERFRONT

16. Do you live on the water?
Yes No (If "No", stop here. Thanks!)

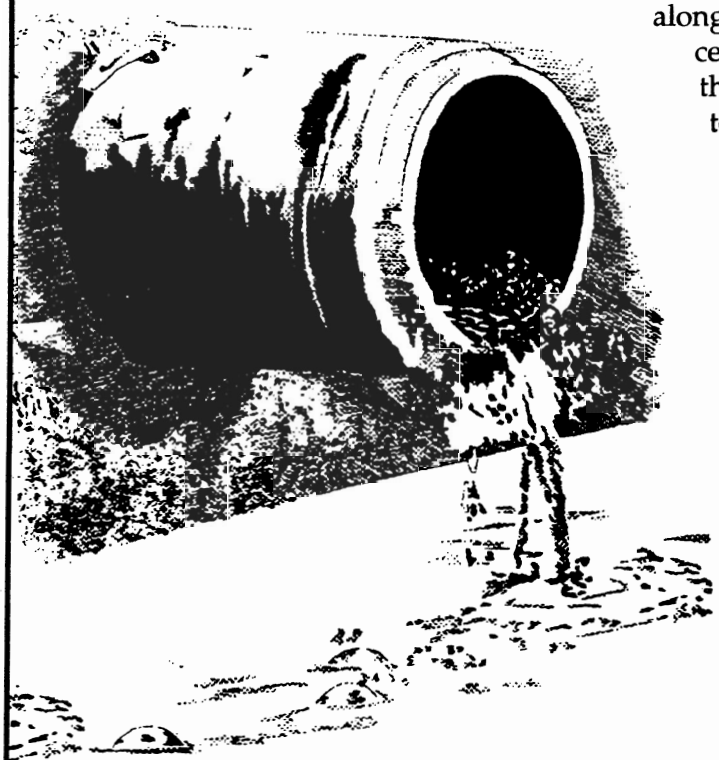
17. Please indicate whether you use any of the following practices.
A border of low maintenance plants has been established or retained between my lawn and the shoreline/seawall.
___ Yes ___ No ___ Don't know
A no-fertilizer, no-pesticide zone 10 to 30 feet wide exists all along the shoreline/ seawall.
___ Yes ___ No ___ Don't know
Native vegetation (i.e. mangroves, pickerel weed, etc.) has been planted or retained in front of the shoreline/seawall.
___ Yes ___ No ___ Don't know
Clean rock or rip-rap has been placed in front of my shoreline/ seawall.
___ Yes ___ No ___ Don't know

When it Rains it Flows

Normally, rain flows through a watershed along a natural course in the form of run-off, or it collects and soaks into the ground. This is usually good for plants and animals out in the wild, but can cause problems for people in developed areas. In particular, rainwater can not penetrate through roads and concrete. This can lead to flooding during storms, which causes damage to property and leads to health problems from standing water. Stormwater managers try to direct and control the flow of run-off and also attempt to limit the amount of pollution it picks up along the way. Pollution is the build up of unwanted or harmful substances in the environment. When it comes from a central source, such as factories or sewers, is referred to as **point source pollution**. It is usually easy to see and control point source pollution. In contrast, **nonpoint source pollution** comes from many different places (industrial, agricultural and residential). It is difficult to find and control this kind of contamination, especially after it is picked up by run-off and carried through out a watershed.

Save the Bay

Non-point pollution is an on-going problem in Sarasota Bay. Stormwater run-off is estimated to contribute much of the suspended solids, and from 30-50 percent of the nutrients, to the bay. This is more than the treated wastewater of both the City of Sarasota and Manatee County combined. Increased development has the potential to produce even more stormwater run-off. Action is being taken by local governments, with the assistance of SBNEP, to address the quality of water entering into Sarasota Bay. This includes an extensive effort to hook up existing septic systems along Phillippi Creek in Sarasota County to central sewer service, and to improve the treatement of stormwater before it enters the bay.



POLLUTION FAST FACTS

- In 2002, 25,284 volunteer collected 1,028,977 pounds of debris from 1,459 miles of Florida's coastline.
- Stormwater is estiamted to contribute 56% of the total nitrogen loading to Sarasota Bay. 60% of this total comes from residential areas.

Learn more:

- Florida Coastal Cleanup <www.floridacoastalcleanup.org>

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Activity 5.1: Create a Model Watershed

Grade Level: 4-6

Standards: see Appendix A and B.

Time Required: 50 minutes.

Objective: The students will learn the function of wetlands in controlling stormwater runoff and the role wetlands play in the world.

Materials:
- ❑ glass baking pan (or clear box)
- ❑ modeling clay
- ❑ turkey baster or spray bottle
- ❑ strip of indoor-outdoor carpet, 3 inches long x the width of the pan
- ❑ clear water
- ❑ muddy water

Suggested Procedures:

1) Spread a layer of the clay in half of the pan to represent land. Leave the other half of the pan empty to represent the bay. Shape the clay so that it slopes gradually into the bay, as in the illustration. Smooth the edges of the clay along the side of the pan to seal it.

2) Use the turkey baster or spray bottle to spray clear water slowly over the clay. This can represent rainfall. Ask the students to observe what happens. (The water runs over the clay and into the depression.)

3) Use the baster to remove the water from the model back into its original container. Show the students the strip of carpeting and ask them to imagine that it represents a salt marsh or mangroves.

4) Take the cut piece of carpeting and completely fill the width of the pan along the edge of the clay where it meets the bay. This represents a marsh. Ask the students to predict what will happen when water is poured onto the clay again.

5) Explain that marshes and mangroves slow the rate of water flow which helps reduce sudden and drastic flooding.

6) Pour the same amount of water onto the model again. Have the students describe what happens. (The water will drain more slowly because it is hindered by a marsh.)

6) Remove the clear water again. Leave the carpet in place, and pour muddy water onto the clay. Ask the students to compare the water that flows through the marsh into the bay with the remaining muddy. (The water that passed through the marsh should be clearer.) This demonstration shows the ability of marshes and mangroves to reduce soil erosion and filter pollutants.

7) Carefully remove the carpet and pour water over the clay again. This shows what would happen if marsh were not there to act as a filter. (All of the pollutants would flow directly into the bay.)

Discussion:

- Q: Florida has lost nearly half of its wetlands since pioneer times due to development or other alteration. What will happen if Florida continues to develop and alter its wetlands in order to accommodate more people?

  A: Greater risk of flooding, more water pollution and erosion, etc.

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Activity 5.1: Create a Model Watershed (cont'd)

- Q: Researchers at the University of Florida have found that when wetlands comprise as little as 10 percent of the landscape, flooding is reduced by 60 percent. When wetlands cover 20 percent of an area, flooding is reduced by 90 percent. Are wetlands valuable in areas where recurring flooding costs homeowners, business owners, and insurance companies millions of dollars?

- Q: Sediment and other pollutants that reach rivers and streams adversely affect populations of fish and other aquatic animals. This in turn affects animals in the ecosystem such as Bald Eagles who depend upon fish for food. What role do wetlands play in the health of the ecosystem?

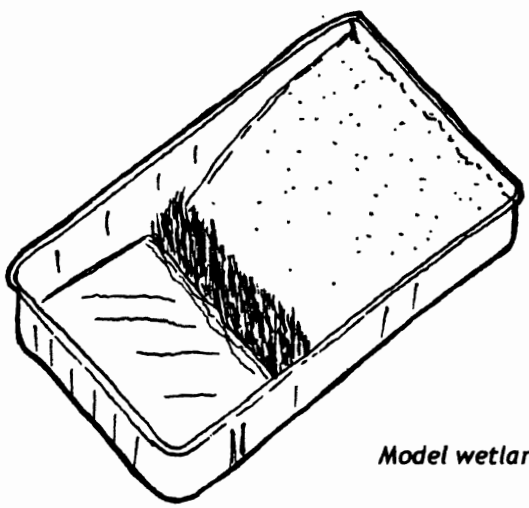
  A: Wetlands help keep water clean.

- Q: Healthy topsoil is important to plant growth. What happens to the ecosystem if the loss of topsoil due to soil erosion suppresses plant growth. Would humans be affected?

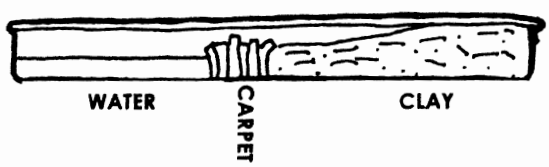
  A: Fewer natural plants would likely result in more water and air pollution - and cause a threat to public health.

Adapted from: SWFWMD and Georgia Water Wise Council. Water Sourcebook. <www.swfwmd.state.fl.us/infoed/educators/splash/buildwet.htm>

See also, <www.marine.usf.edu/pjocean/packets/sp00/s00u3le1.pdf>



Model wetland diagram



Activity 5.2: After the Flush

Grade Level: 6-8

Standards: see Appendix A and B.

Time Required: 50 minutes.

Objective: Students will learn the role that septic systems play in contributing to pollution.

Materials:

- ❑ large, clear, water-proof container
- ❑ play sand (enough to cover the bottom of the container to a depth of one to two inches)
- ❑ small, clear container with lid (model septic tank)
- ❑ modeling clay (kind that never dries out and is not affected by water)
- ❑ flexible drinking straws (4)
- ❑ small funnel
- ❑ water
- ❑ pony beads, smaller beads, and glitter (simulated waste)
- ❑ food coloring
- ❑ awl or icepick

Suggested Procedures:

1) Before you begin to build the model you need to prepare some of the materials. (This will be an important safety issue if you are using the model in a classroom situation.)
   - Take three of the straws and using an awl (or an ice pick) poke holes along the length of the straws.
   - Drill or punch a hole into the model septic tank in the center of one side near the top. This hole should be just big enough for a soda straw to fit into.
   - Punch a hole into the lid of the model septic tank that the small end of the funnel will fit into. This hole should be positioned so that the funnel can be held in place along the side of the large container, and still fit in the hole.

2) Now that you have finished using the sharp tools to prepare the materials, you are ready to begin the actual construction itself.

3) Fill the large container with one to two inches of play sand. This is the "earth" that will hold the tank and the leaching field for the septic system.

4) Use a small section of straw to make an outlet pipe and connect it from the septic tank to where the leach field will be. Seal the joint with modeling clay.

5) Place the model septic tank into the large container, so that the outlet pipe (straw) is lying just on the surface of the sand.

6) Connect the three perforated straws using modeling clay as shown in the diagram, trying to keep the field as level as possible. (It should slope at about a 1% gradient. Water needs a slope to flow, but you don't want to design the system with such a steep gradient so that all the water rushes to the ends of the pipes. You can have your students calculate what a 1% gradient would be over a given distance for a regular system.

7) Seal the ends of the straws with a little modeling clay.

8) Put a little clay into the bottom of the tank to simulate the sludge that is normally found coating the bottom of the tank. Place some beads into the tank. (The clay will also allow you to keep some of the beads from floating.)

9) Place the funnel in the hole in the tank lid and seal the connection with modeling clay. Now the model is built, you are ready to do the simulations.

Developed by Mote Marine Laboratory for P.I.E.R., a program of the Sarasota Bay National Estuary Program

Activity 5.2: After the Flush

10) First, slowly add water to the system through the funnel.
   - What happens if you add too much water?

11) Add some glitter.
   - Describe what happens. What do you think the glitter might simulate?

12) Add some food coloring and wash it into the system with a little water.
   - Describe what happens. What do you notice with the food coloring? What might it simulate?

Discussion:
How would the following substances would act in a home septic system
- solvents
- oils
- hazardous materials
- bleach
- anti-bacterial soaps and detergents

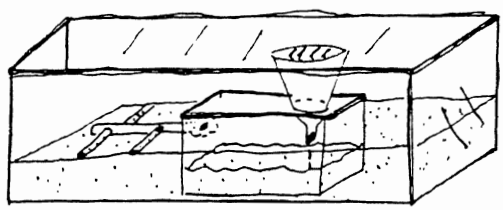
Extensions:
- Try different slopes on the leaching bed, like 0%, 1%, and 2%. What will happen if the slope is too great?
- Research your county regulations on septic systems.
- List some common contaminants in ground water and describe how they could have gotten there.
- List common hazardous materials that may be found around the home.
- Brainstorm about where these would be stored or used in the home.
- Ask how one should properly dispose of any hazardous material "leftovers"
- What effect do different types of soils have on the effectiveness of the leaching system?

- Sarasota County is replacing septic systems with central sewer connections in many neighborhoods. Visit their website to learn more about this process:

  <www.mycentralsewer.com>

  List some pros and cons of septic systems and of central sewer connections.

Adapted from: Purdue University Cooperative Extension Service. Down the Drain and into the Yard.
<www.ecn.purdue.edu/SafeWater/kids/ActivityFour.pdf>



Model septic system diagram

Standards

NATIONAL SCIENCE EDUCATION STANDARDS	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2
Science Content Standards										
Life Sciences [5-8]										
Structure and function in living systems			x	x	x	x	x	x		
Regulation and behavior			x	x	x	x	x	x		
Populations and ecosystems			x	x	x	x	x	x		
Diversity and adaptations of organisms			x	x	x	x	x	x		
Earth Sciences [5-8]										
Structure of the Earth system	x	x								
Science in Personal and Social Perspectives [5-8]										
Population, Resources and Environments									x	x

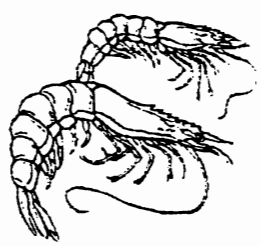
National Countcil of Teachers of English	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2
Standard 3: Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features		x	x	x	x	x	x	x		
Standard 4: Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.		x	x	x	x	x	x	x	x	
Standard 5: Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.		x	x	x	x			x		
Standard 7: Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.			x	x	x	x	x	x		
Standard 8: Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.		x	x	x	x	x	x	x		x
Standard 12: Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).		x	x	x	x	x	x	x	x	

National Education Technology Standards	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2
Technology communications tools										
Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.			x	x	x	x	x	x		
Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.		x	x	x	x	x	x	x		
Technology research tools										
Students use technology to locate, evaluate, and collect information from a variety of sources.			x	x	x	x	x	x		
Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.	x	x	x	x	x	x	x	x	x	x

Science Standard	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2
Processes that Shape the Earth										
SC.D.2.2 The student understands the need for protection of the natural systems on Earth.	x	x	x	x	x	x	x	x	x	x
Processes of Life										
SC.F.1.2 The student describes patterns of structure and function in living things.			x	x	x	x	x	x		
SC.F.1.2.3- knows that living things are different but share similar structures			x	x	x	x	x	x		
How Living Things Interact with Their Environment										
SC.G.1.2 The student understands the competitive, interdependent, cyclic nature of living things in the environment.			x	x						
SC.G.1.2.1- knows ways that plants, animals, and protists interact			x	x	x	x	x	x		
SC.G.1.2.2- knows that living things compete in a climatic region with other living things and that the structural adaptations make them fit for an environment			x	x	x	x	x	x		
SC.G.2.2 The student understands the consequences of using limited natural resources.	x	x	x	x	x	x	x	x	x	x
SC.G.2.2.1- knows that all living things must compete for Earth's limited resources; organisms best adapted to compete for the available resources will be successful and pass their adaptations to their offspring			x	x	x	x	x	x		
The Nature of Science										
SC.H.1.2 The student uses the scientific processes and habits of mind to solve problems.	x	x	x	x	x	x	x	x	x	x
SC.H.1.2.2- knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results	x	x	x	x	x	x	x	x	x	x
SC.H.3.2 The student understands that science, technology, and society are interwoven and interdependent.	x	x	x	x	x	x	x	x	x	x
SC.H.3.2.2- knows that data are collected and interpreted in order to explain an event or concept	x	x	x	x	x	x	x	x	x	x
SC.H.3.2.4- knows that through the use of science processes and knowledge, people can solve problems, make decisions, and form new ideas	x	x	x	x	x	x	x	x	x	x

Appendix B: Sunshine State Standards

LANGUAGE ARTS STANDARD	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2
Reading										
LA.A.2.2 The student constructs meaning from a wide range of texts.		x	x	x		x		x		
LA.A.2.2.1- reads text and determines the main idea or essential message, identifies relevant supporting details and facts, and arranges events in chronological order			x				x	x		
LA.A.2.2.2- identifies the author's purpose in a simple text			x				x	x		
LA.A.2.2.5- reads and organizes information for a variety of purposes, including making a report, conducting interviews, taking at test, and performing an authentic task			x	x	x	x	x	x		
LA.A.2.2.8- selects and uses a variety of appropriate reference materials, including multiple representations of information, such as maps, charts and photos, to gather information for research projects			x	x	x	x	x	x		x
Listening, Viewing, and Speaking										
LA.C.1.2 The student uses listening strategies effectively.	x	x	x	x	x	x	x	x	x	x
LA.C.1.2.1- listen and responds to a variety of oral presentations, such as stories, poems, skits, songs, personal accounts, and informational speeches	x	x	x	x	x	x	x	x	x	x
LA.C.1.2.4- listens attentively to the speaker, including making eye contact and facing the speaker	x	x	x	x	x	x	x	x	x	x
LA.C.3.2 The student uses speaking strategies effectively.	x	x	x	x	x	x	x	x	x	x
LA.C.3.2.1- speaks clearly at an understandable rate and uses appropriate volume	x	x	x	x	x	x	x	x	x	x
LA.C.3.2.3- speaks for specific occasions, audiences, and purposes, including conversations, discussions, projects, and informational or imaginative presentations	x	x	x	x	x	x	x	x	x	x
LA.C.3.2.4- uses eye contact and gestures that engage the audience	x	x	x	x	x	x	x	x	x	x
Language										
LA.D.2.2 The student understands the power of language.	x	x	x	x	x	x	x	x	x	x
LA.D.2.2.1- understands that word choice can shape reaction, perception, and beliefs	x	x	x	x	x	x	x	x	x	x



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