Bird Island Basin

Environmental Study Area

Richard V. Harris
Padre Island National Seashore

TEXAS A&M
SEA GRANT
COLLEGE PROGRAM

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by Richard V. Harris
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Foreword

The concept of environmental study areas was a direct outgrowth of the ecology movement of the 1970's. The idea was to designate specific areas where school groups, youth groups, or other groups of children or teens could enjoy a directed study experience in the field and where specific ecological principles could be demonstrated. The awareness of environmental study areas has declined with emphasis on new topics and with allocation of funding to other projects. Also, as funding for field trips has become more scarce, it is often not possible for a teacher to take a class away from school into the field. All of the principles discussed in this guide are applicable anywhere. The specific exercises were written with the Bird Island Basin area in mind, but they may be easily adapted to environments other than those found on Padre Island. Many of the activities can be done on the school lawn, on the playground or in a nearby city park. Partial answers to many of the questions posed in the guide are included in the text and are indicated by square brackets.

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BIRD ISLAND BASIN ENVIRONMENTAL STUDY AREA

Padre Island is a recently formed barrier island. Geologic evidence indicates that it has formed since the last ice age 12,000 years ago and has attained its present form within the last 3,000 years. The exact steps of its formation are still not fully understood, but they involve the alongshore transport of sediment from the major river systems of the Gulf Coast; the movement of sediment toward the mainland by wind, surf and currents; and the rise of sea level due to melting glaciers. One possible sequence is as follows:

Melting glaciers added thousands of cubic miles of water to the world's oceans and caused a rise in sea level of between 300 and 400 feet. By 3,000 years ago, the oceans had risen to their present levels. During the period of rising sea level, along-shore currents carried sediment to this area from the Mississippi, Brazos, Rio Grande and other rivers north and south of here. Surf and conflicting currents deposited this sediment to form a series of sand bars and dunes along the shore. The rising oceans isolated these bars to form islands. After the sea level stabilized, the continuing deposition of sediment connected the islands to form one long barrier island separated from the mainland by a shallow lagoon.

The ecosystems that may be seen on Padre Island are varied and they reflect this sequence to some extent. Sediment is still being deposited on much of the beach of Padre Island. Wind is still moving sand across the island and depositing it in the shallow waters of the Laguna Madre. The vegetation that we see on the island may have spread from the species that were isolated by the rising sea level. Wildlife has probably migrated to the island from the mainland by crossing the Laguna Madre. A few species may have been stranded here by the rising ocean.

Barrier islands are significant today because of the breeding habitats that they create and the protection that they give to the mainland. The Laguna Madre is a prime breeding ground and nursery for many forms of sea life that we value commercially. It also provides rookery areas for many species of bird life.

The island breaks the force of the high tides and heavy surf caused by storms, absorbing the energy that would do much damage to the mainland. (Some large bays behind the barrier islands may generate their own high tides and surf during major storms, but the energy content of these tides is always less than that of the open ocean.)

The Bird Island Basin area is typical of the Laguna Madre side of the island. Here you will find a variety of ecological zones including bare sand dunes, deflation plains, mud flats, vegetation beginning to stabilize dunes, and a shallow water lagoon teeming with life. The area provides an opportunity to see the result of man's activity on the island and to compare it with areas that man has left undisturbed. In the shallow water of the Laguna Madre, you may find many creatures that use this large body of water as a place to grow and mature.

Environmental study areas provide the opportunity for directed group learning experiences in a field situation. Hopefully, they stimulate the imaginations of the students and lead them to a better understanding of the cultural and natural worlds that surround us and of the ways that these worlds interact.

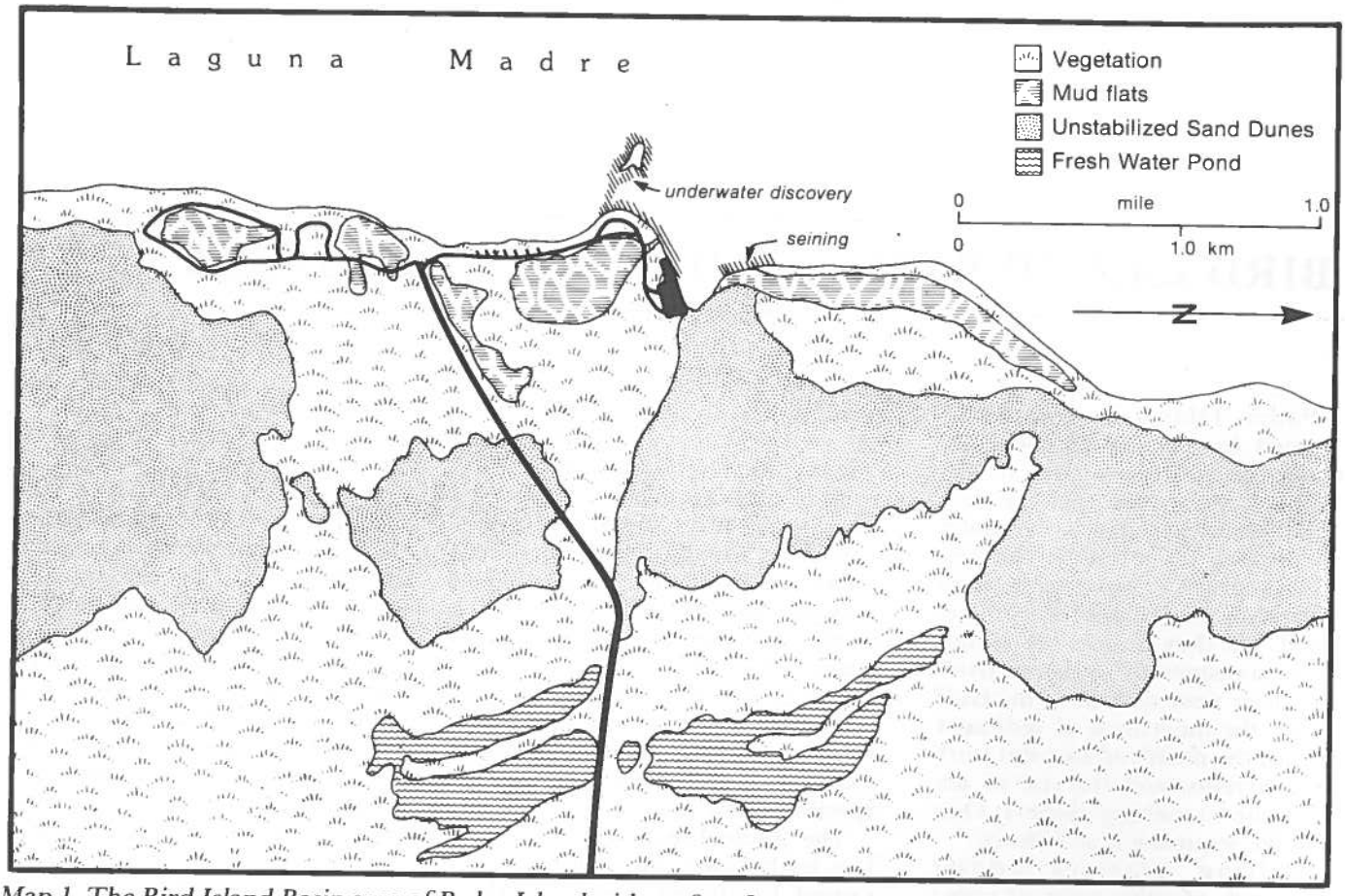
This guide is designed to be a supplement to the regular school curricula. It contains a number of exercises that are designed as points of departure for intimate hands-on learning experiences. Most of the suggested activities are presented in a format similar to high school-level laboratory experiments. We encourage you to modify the formats and contents of the material to meet the needs of the your group. We also hope that you and your group will discuss man's role in the environment as you engage in any of these activities.

The references listed at the end of the guide may be available through your school library, the public library, your local bookstore, or the literature sales outlet at the National Seashore.

Pre-Trip Planning

You will undoubtedly spend some time studying the subject matter that you hope to cover in the field. This guide may provide some study materials for classroom use or ideas for pre-trip activities. Please feel free to use or adapt any portion of this document to your lesson plan. On a given trip, you may wish to combine portions of different activities to cover a broader range of material.

If the National Seashore staff can be of assistance to you either in planning the trip or in doing the exercises in the field, please feel free to call us. Give us as much lead time as possible so that we can plan our schedule and avoid conflicts. Contact the Park Naturalist staff at 512/949-8068 for further



Map 1. The Bird Island Basin area of Padre Island with surface features present in 1981 shown. The island changes from year to year and the features, while still present, may be in different locations or more or less abundant.

information. The park has movies that we will lend to school groups for use in the classroom and it may be possible for us to visit you in your classroom to review some of the activities if you cannot take a field trip.

If you have made arrangements for a program with one of our staff and find it necessary to cancel, please let us know as soon as possible. We may be able to reschedule the program with you at another time and use the original time for another group.

The Laguna Madre

This shallow body of water (average depth is only 4½ feet) separates Padre Island from the mainland. It is connected to the Gulf of Mexico in only three places in its 115-mile length and water exchange with the Gulf is very limited. Because of this limited exchange and the lack of fresh water from other sources, the Laguna fluctuates drastically in salinity. Temperatures also vary much more than in the open Gulf because of the relatively small volume of water to be heated (by solar energy) or cooled. The Laguna is less subject to tidal fluctuations than the Gulf and bays of the Texas coast, but may rise or fall drastically with strong winds.

The Bird Island Basin Area

Bird Island Basin is located on the shore of the Laguna Madre approximately 14 miles south of the Kennedy Causeway. While the immediate area is very popular for boating and fishing, the land only a short distance from the access road receives very little human visitation. The basin is on the west side of Padre Island and is characterized by open areas of sand and flat plains of dense vegetation. The water along the shore is shallow and ideal for studying some of the life forms that abound in the Laguna Madre.

To reach Bird Island Basin, travel south along Park Road 22 into the National Seashore. You will see a road to the right of Park Road 22 and a sign directing you to Bird Island Basin when you reach 2.2 miles from the entrance to the National Seashore. Follow this road to the "Y" fork, and take the right fork to the parking area (see map). The best area for working with school groups is north of the parking area behind the large willow trees.

The area that you will be visiting is mostly loose sand interspersed with areas of dense vegetation. The only shade comes from the willow trees that are near the parking area. Walking is fairly easy, but tiring. Sun, wind, insects and hot or cold temperatures are environmental factors that you will want to consider and prepare for. Footwear should be comfortable for walking, but should protect the feet from thorns, burrs or shells buried in the sand. Clothing should be appropriate for the sea-

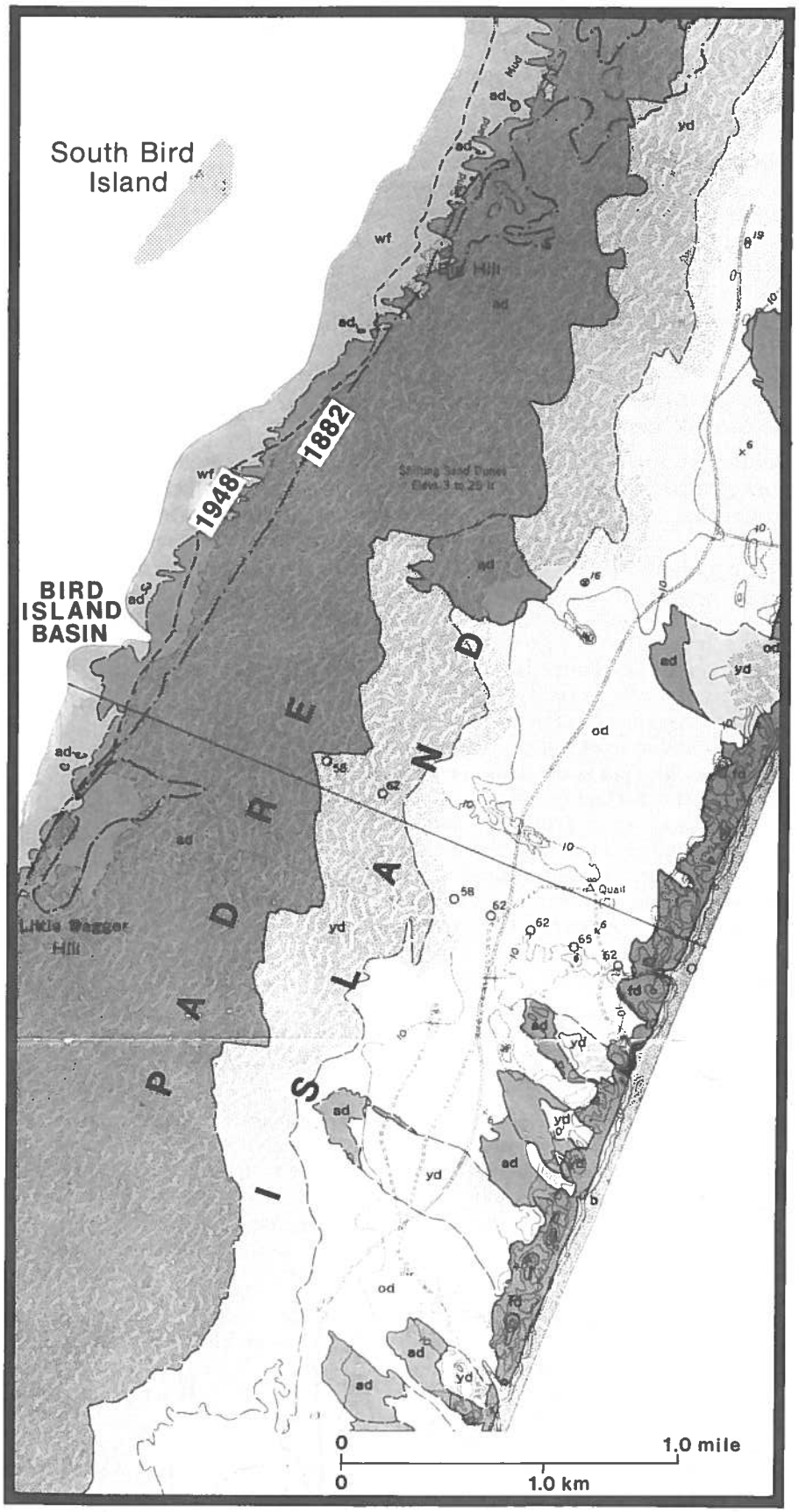
son, but basically offer protection from the sun and stickers. A hat or other headgear is desirable in all seasons. Insect repellent is a must. Drinking water is not available on site and should be brought along. Restroom facilities are limited to portable toilets. The immediate presence of the Laguna Madre is an attraction to children and they should be properly dressed if they are allowed to get wet. (We recommend that shoes be worn while wading.) If you do not plan to allow the students in the water, you should plan your activities away from the shoreline.

Other items you might need are a first-aid kit; paper or plastic bags for the students to collect shells, feathers or other similar items; any equipment for special activities; and lunches if the class is to be in the Seashore during lunchtime.

Emergency services, first aid, water and restrooms are available from 8 a.m. until 4:30 p.m. at the Ranger Station three miles from the boat launch area. Interpretive services and exhibits at the Malaquite Pavilion are open from 9 a.m. until 4 p.m. Restrooms and running water are available 24 hours a day at the pavilion and at the campground.

Federal regulations prohibit collecting any living plants or animals within the Seashore boundaries. We, therefore, ask that you emphasize that the students **not** pick any flowers or sea oats or molest any animal during your visit. Students may collect seashells that contain no living organisms. You may also seine for small fish in the Laguna Madre or collect shellfish and hermit crabs on a capture and release basis without special permits. Texas game laws require that you have a license to use a net or seine.

There are a number of general and specific regulations that govern the use of the National Seashore. Those that apply to school groups, and additional regulations provided for your information, are included in Appendix C. Appendix A includes some simple first-aid instructions, and Appendix B lists sources for equipment and instructions for making your own.



Map 2. A section of a geologic map of Padre Island showing Bird Island Basin. Approximate shorelines are shown for the years 1882 and 1948, with the actual shoreline for 1967 indicated by the solid line.

Purpose: To examine some of the non-biological factors of the environment, to provide ecology-oriented exercises for physics and chemistry classes and to instruct the group about the geologic origins and present geologic activity at Padre Island, a barrier island.

Equipment: Clean containers for sand and water
Devices to measure slope on the sand dunes
Thermometer
Magnifying lens
Two small balloons
Pencil and paper

Challenge: Discover the many ways that the geology of Padre Island differs from one area to another, learn that the geology of the island is still dynamic, examine the effects of the forces of wind and water on the shore, and equate the laws of physics and the uses of chemistry to a natural area.

Guide: Normally an environmental study area is designed to work primarily with the life science or ecology class. There are numerous opportunities, however, for the physical science teacher to do field exercises and to equate the sciences of geology, physics and chemistry to the "real world." While this list of exercises is not exhaustive, hopefully it will provide you with some places to start in our efforts to demonstrate the values of these sciences to our everyday lives.

The geology of Padre Island is a very interesting subject and it lends itself easily to field study. Most evident in the Bird Island Basin area is the effect of wind. On almost any day that you visit, there will be at least a little breeze and a little wave action along the shore. Move a short distance away from the parking lot and examine the surface of the sand. You should find a variety of animal tracks, some fresh and some old. What is the difference between the fresh tracks and the older tracks? What does this tell us about the movement of sand? If there is even a gentle breeze, you will be able to watch the sand move on the exposed faces of the dunes. There are two faces to most dunes, a "pack face" and a "slip face." Which is which? How can you tell? What role does the wind play in creating them?

Key Words:

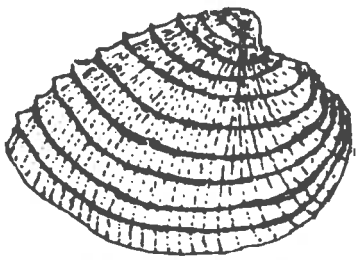
pack face
erosion
sediment
dune
angle of repose
crystalization
element
pH
slip face
deposition
island
blow-out
compound
solvent
acid
cross-bedding
littoral
barrier island
stabilized dune
relative density
contamination
alkali (base)

Sea oats are one of the few plants that can grow in moving sand.

1. In May 1978, the boat dock or pier at the end of the basin was at the edge of the water. Measure the distance from the dock to the edge of the water today. If the island has widened this much throughout its 113-mile length, how much new land has been created in the last few years? [Sample calculation: assume that the island is 10 feet wider. 10 ft x 5,280 ft per mile = 52,800 sq ft per mile. 113 miles of island thus yields 5,966,400 square feet, which is equal to nearly 137 acres.] If we assume that the sand that has widened the island is 2 feet deep, how many cubic yards of sand have been moved since 1978? [5,966,400 sq ft x 2 ft deep = 11,932,800 cu. ft, which is equal to 441,955 cu. yd. 11,932,800 cu. ft divided by 27 cu ft per cu. yd. = 441,955.] Enough land has been added to Padre Island to operate a dairy farm or to build a dam larger than the dam at Lake Corpus Christi. What does this tell us about what is happening to the island? To the Laguna Madre?
2. There are at least three types of surface materials in the area, sand, clay and shell. The sand has moved across the island from the Gulf side where it was

deposited. Ilmenite (an iron-titanium compound) is present in trace amounts in the form of black sand. It is heavier (more dense) than the white sand and tends to accumulate in the bottoms of the ripples. The shell may have come from several sources. The oyster shell found in several spots was brought in by man to support man-made structures. Much of the other shell is remnant from a time when the area was under water or at the edge of the water. It accumulated as animals died and left their shells on the bottom. Clay originated in much the same way as the sand, but it was carried to the area by gentler currents and may have been transported through Laguna Madre rather than the Gulf of Mexico.

3. Locate traces of ilmenite in the sand. Does the pattern of these deposits tell you anything about how minerals are concentrated in the environment? What agent is primarily responsible for concentrating the minerals that you see? [wind] Would this mode of concentration yield deposits that are valuable to man? Collect a small sample that contains both kinds of sand and take it back to the laboratory. Separate the ilmenite from the other sand, and measure the relative densities of the two materials. Examine the two types of sand under a microscope and observe patterns of crystalization (if present). Do these patterns tell anything about the structure of the two materials? Analyze the ilmenite chemically to determine its exact composition. (This can be done as a demonstration for the average class. Advanced students might attempt it as a special exercise. The material is basically an iron titanium oxide with traces of other elements.
4. What factors in the environment are most active in shaping the geology of Padre Island. Do these factors differ from those that form islands such as Hawaii? [yes] How?



Cross-barred venus live in the Laguna.

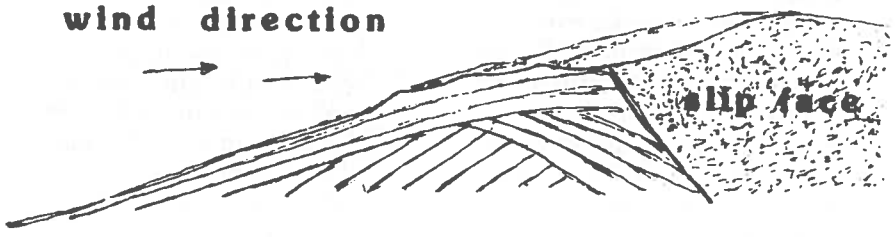
[volcanism versus sedimentation] What parts do plants play in geology? What parts do animals play? [Both move soil, and plants slowly break rocks into soil. Plants also cause soil to collect and remain in an area.[Find evidence to support your conclusions.

5. Collect a small sample of each type of soil that you find and take it back to the classroom. Examine each under a powerful magnifier. What do the shapes of the soil particles tell you about the kinds of sediments? [Crystal shape is characteristic of specific minerals. The amount of wear on the crystals indicates the length of time that the particles have been moving and eroding.] What do they tell about the actions of wind and water on the sediments? [These elements erode and degrade individual particles regardless of particle size.]
6. What is the main sorting agent in the Bird Island Basin area? [wind] How does it work? Find evidence that it is working during your visit. Take a small sample of sand from a bare sandy area. Place it in a shallow dish and wash it gently with water (swirl the water over the sand). What happens? [Heavy particles sink, light particles float and are separated by the washing.] A shallow pie pan works well for this experiment. This method of sorting heavy particles from lighter ones was used by miners to "pan" for gold. If there is a breeze, slowly pour sand from a container and observe the sorting action of the wind. Does this explain some of the concentrations of sediments that you find?
7. The soil that forms Padre Island began as rock in western mountains or in the Hill Country of Texas. Erosion by wind and rain, cracking of the rocks by alternate freezing and thawing or by the constant pressure of plant roots or other weathering factors broke the bedrock into boulders. Water running in streams carried the boulders downstream, breaking them into ever smaller pieces. As the streams formed rivers, the amount of material they carried became tremendous but the sizes of the particles grew smaller. As the rivers emptied into the Gulf of Mexico, most of the materials was suspended as fine sand or clay — materials that settle to the bottom only slowly. Oceanic currents carried the suspended materials along shore where they finally settled to the bottom. Surf and wind action on the water moved this sediment toward shore to form sand bars and, eventually, Padre Island. They are still moving sediment ashore today. As the sand reaches the beach and dries, it is picked up by the wind and carried inland. Some adds soil between plants, and some travels across Padre Island to fall into the Laguna Madre.

   Have members of the group take the roles of ROCK (several members together for each piece), SAND, WIND, RAIN and OCEAN CURRENT. Trace the path of the sand on the beach from the original rock through the erosion and transport processes. Have the students representing wind and rain separate the groups of "rock." Have the rivers and ocean currents move the "rocks" (one "piece" at a time) and deposit them on the "beach." Have the wind move them once again to the area that you designate as Bird Island Basin. Does this explain why there are no rocks on

Padre Island? What else does it teach? [How soil is formed from rock.]

8. Locate a damp area in the dunes (unvegetated dunes, please) and carefully cut the side of the dune to expose the layers of sand. You should be able to find crossbedding, which is caused by the wind driving sand from several different directions. The side that is the pack face of the dune in the summer may be the slip face in winter. Each wind-deposited layer is visible in the cross-section of the dune. If you repeat the experiment at the edge of the water, you probably will not find crossbedding. Why? [Waterborne sediments are usually deposited in flat beds and from the same direction] Discuss the difference between wind-borne sediments and water-borne sediments and how they can be distinguished.
9. Discuss the erosion factors at work on Padre Island today. Can you see any of them at work? Which ones? Is the island changing or is it stable over a long period of time? [changing] How can you tell? [presence of blow-out dunes on the back side of the island and obvious erosion or deposition of sand on the Laguna shore] What are the effects of man on the geology of Padre Island?
10. Water is essential to all life forms; it also is the universal solvent. Most life forms need "fresh" water and clean water. Collect samples of water from ponds created by rainfall and from the Laguna Madre. Use clean containers to avoid contamination. Fill a small balloon with fresh water from one of the ponds or from your drinking water supply and place it into a container of saltwater from the Laguna Madre. What happens? [It should float] Reverse the experiment by putting the saltwater into the balloon and placing the balloon into fresh water. What happens? [The balloon should sink] Why do you get these results? [Salt water is more dense than fresh water. A more dense fluid will support a less dense fluid if the two are not free to mix.] In the laboratory, determine the amounts of dissolved material in each sample. Ocean water averages about 35 parts-per-thousand salt and has traces of other minerals. Can you detect other elements or compounds in your samples? How much salt is present in the sample you collected from the Laguna Madre?
11. Measure the pH of the water samples you have collected. [pHydrion strips are available through the suppliers listed in Appendix B or at some tropical fish stores. These provide a simple test for pH that may be used in the field as well as in the classroom.] How much do the samples differ? What natural causes might explain the difference (if any)? Locate an area in the Laguna Madre where dead shoal grass and algae have collected and take a sample from the water within or immediately above the dead plants. Can you detect any compounds that were not present in the other samples? Is the water collected near the dead vegetation more acid or more alkaline than the other samples you have collected? What effects will this have on any life forms that might live there? [There often is an easily detected amount of hydrogen sulfide, H_2S, dissolved in the water around dead vegetation. This gas has a strong rotten-egg odor and it is very poisonous to all living things. It is rare to find any living animals where H_2S is present.] Is this a form of pollution? What is the importance of monitoring the acidity of water? [Water that is too acid or too alkaline will not allow life to exist. Acid rain has made many of the rivers in New England uninhabitable by any form of fish.] Discuss the methods by which acid waters might be made pure again and the general ways that polluted waters might be cleaned. Emphasize the role of chemistry in these processes.
12. Find a bare sand dune and examine it. You will find that one face is fairly solid while the other is loose sand that slides after only a slight disturbance. The sand on the loose or slip face has reached the angle of repose. What principles of physics govern the angle of repose? [resting friction, inertia, gravity] If the particles were cubes with perfectly flat sides, would the angle of respose be different? [No] What forces are acting while the sand is undisturbed? After the sand begins to slide? What does this teach about the difference between resting and sliding friction? How is this information valuable to an engineer? [The engineer may have to determine the steepest safe angle for material along a road or trail.] Find a place on a dune where the sand forms a wall or vertical face. Why is this sand able to form a slope that exceeds the angle of repose? [The grains of sand are held in place by a mineral that has been dissolved and redeposited between the grains to form a natural cement.]



A cross-section of a sand dune showing cross-bedding.

tracks in the sand

Purpose: To trace the life forms that exist on the island that may not be directly observed and to learn at least a little about their existence.

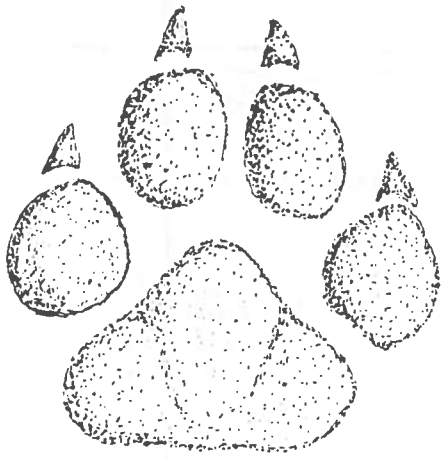
Equipment: Field guide to animal tracks
Plaster of Paris
Cardboard for molds
Fresh water

Challenge: To learn as much as possible about the creatures that live in the Bird Island Basin area by studying the tracks that they leave in the sand.

Guide: In the soft sand and mud along the shore of the Laguna Madre, we may find the tracks of many animals and plants. Often, tracks are the only evidence that we will see. The animals that made them are active at night or early morning. There are a number of activities which may interest a group that may be done using these tracks.

Key Words:
cast
scat
track
den
sign
predator
social interaction

1. Follow a set of tracks as far as you can and recreate the animal's activities as indicated by the tracks. Areas of concentrated tracks may indicate feeding or searching for food. Tracks spaced out in a line obviously indicate movement, but the amount of spacing between the tracks may indicate a number of things. Tracks closely spaced indicate no hurry. The animal may have been searching for food or just out for a walk. Tracks moderately spaced indicate movement with a purpose. Was the animal returning to its den with a load of food? Tracks widely spaced show rapid movement. Could the animal have been fleeing from a predator? If so, look for the predator's tracks (remember, hawks and owls won't leave any tracks). Look for evidence of social interaction where two animals meet. [Social interaction may be combat, mutual avoidance or mutal examination. The term basically means the thing that it would mean with humans.]
2. Identify as many animals and birds as you can from the tracks that you find. Discuss how the feet and tracks of these creatures differ and what this may tell us about the animals themselves. [Webbed feet for swimming, hand-like paws for grasping, large feet to support the animal on soft surfaces, etc.]
3. Make plaster casts of the tracks that you find. Discuss the track with the group before you make the cast. [What kind of animal made the track? What food does it eat? Where does the animal live?] In the classroom, recreate the area using the casts and discuss how the feet of each animal are adapted to its lifestyle, how the animals interact and why each is important to the general ecology.
4. Find tracks in the sand that were made by plants. How can the plants make tracks when they don't move? [Wind moves the leaves across the sand.] Do these tracks cause any changes in the environment that would not otherwise occur or would occur more slowly? [Hint: plant tracks are usually grooves that have been eroded in the sand.]



Coyote track

Kangaroo rat footprints

[Making plaster casts is very simple and it is an activity that more pre-teens or early teens will enjoy. You will need some plaster of paris, fresh water, a can and cardboard for the mold. Place the cardboard or other material around the track to form a mold about an inch deep with the ground as the bottom. Leave about an inch on all sides of the track that you are going to cast. Mix the plaster and water to make a soupy mix—about the consistency of cake or pancake batter. Carefully pour the plaster of paris into the mold and allow it to harden (20 to 30 minutes). When the plaster is completely hard, you may pick it up and peel the paper mold away from it. Mark each cast with the type of animal and the name of the student who made it. Tracks in slightly damp sand will yield better results than tracks in dry sand. Allow about one-half pound of plaster (dry weight) per cast and nearly a pint of water per pound of plaster (this will allow some for spillage).]

plants

Purpose: To teach the student the values of plants in the environment, how plants grow and how plants differ.

Equipment: Field guide to plants/wildflowers
Simple key to plant species
Guide to edible plants
Pencil and paper

Challenge: Identify several species of plants using a simple key; learn the values of plants and the role they play in the environment.

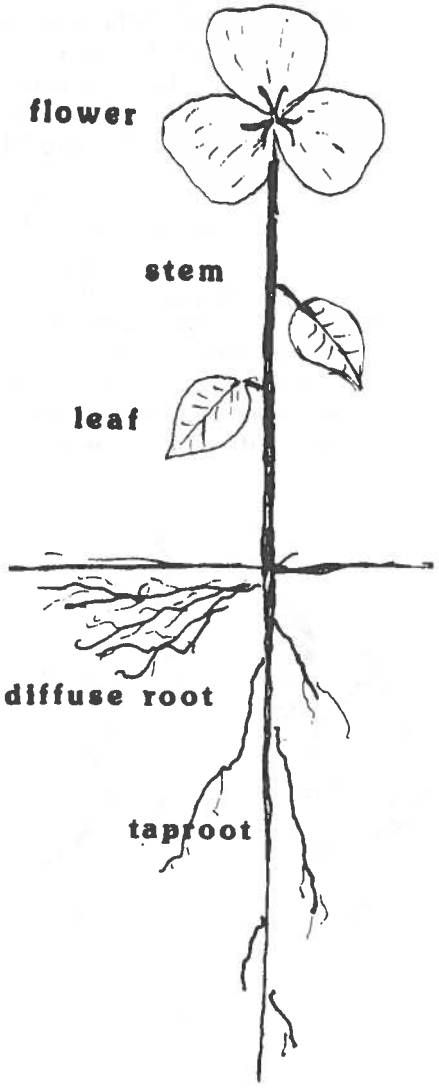
Guide: As you move away from the water at Bird Island Basin, notice the different types of plants. What types of habitat does each plant seem to grow in? Are there areas where no plants are growing?

There are many different species of plants here. How are they different? [Look for differences in types of stem, leaves, flowers, growth requirements.] How are they the same? Can you identify some of the more common plants with the key that is provided? Most plants are identified by their flowers if they have flowers. How many different flowers are there here today? How are they different? How are flowers important to plants? [reproduction] Use this format of questions to lead the class into the world of botany.

Key Words:

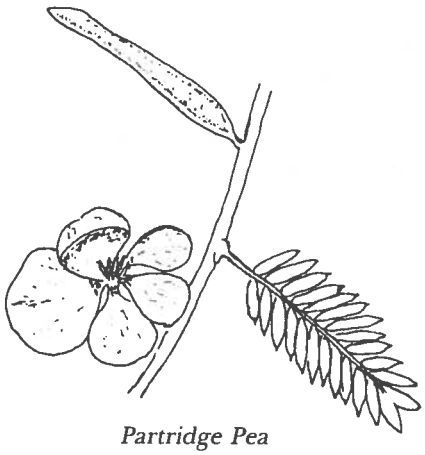
photosynthesis
roots
leaves
evergreen
plant succession
perennial
competition
chlorophyll
taproot
flowers
bark
climax community
compound leaf
nutrient
stems
diffuse root
deciduous
pollination
annual
simple leaf

1. What is plant succession? [Plant succession is the process whereby the composition of the plant community changes over time as the conditions of the habitat change. The climax community is that grouping of plant species that will dominate a given habitat unless outside forces such as fire interfere.] Locate examples of plant succession in the Bird Island Basin area. [The most obvious example is that of the willow trees replacing the grass and shrubs.] How does competition relate to plant succession? [Plants, like all other living things, must compete for their food and water. Those individuals or species that are best able to compete will survive and will replace those that are less able to compete. The climax species of any community are those species that are able to out-compete all other species and are best able to survive in a given habitat.]
2. What parts of plants are good to eat? Can you identify an animal that eats the roots? The stems? The bark? The leaves? The flowers? [One example in all cases is man.] Are there plants here that eat animals? If there are, try to find some. [The common sundew is a close relative of the Venus flytrap and eats small insects or other invertebrates. This plant is most easily found near stops 8 and 11 on the Grasslands Nature Trail in the spring.] Are there live plants that have no chlorophyll? How do these plants get their food? [Fungi such as mushrooms and toadstools have no chlorophyll and no circulatory system. Because they have no chlorophyll, they lack the green color that we associate with plants.]
3. Many plants live on the land, but there are also plants that live in the water. How many can you find? How are they the same as plants that live on the land? [They have cholorphyll, manufacture sugar from water and carbon dioxide, have roots, stems, leaves, etc.] How are they different? [They are adapted to obtaining their needs from the water rather than from the air. Not all plants will have all plant parts and most stems do not provide support. Note: algae are basically one-celled plants living in a colony and each individual plant usually obtains its own nutrients and manufactures its own food. Algae are commonly found in the water.]

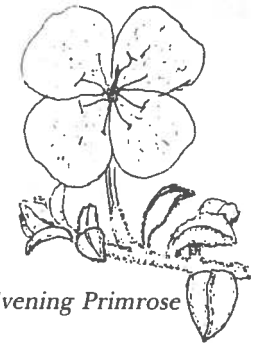


4. Examine the plants near the boat launch area. Some plants will be found growing on the tops of dunes. What kinds of root systems do these have? [Most often they will have diffuse root systems.] Find some of the low-growing shrubs such as the partridge pea or primrose that have had the roots exposed by erosion. Are there differences in the root systems? [Roots on these shrubs will tend to be heavier and to descend deeper into the soil even though they may lie near the surface for some distance. Again the system is basically a diffuse root system. Taproots will be found on the willows and a few other species but will rarely be visible.]
5. Some plants live for only one year. These plants are called *annuals*. How might this short life help the species to survive? [The plant has no need to develop major storage organs for food and no need to adapt to unfavorable growing conditions during summer/winter and/or drought.] Perennials may live for two or several years and they have evolved the ability to store food in the roots and stems in order to survive periods unfavorable to active growth. (The bristlecone pines have been found to live for more than 5,000 years.) You will generally find some dead plants. What might have caused them to die? Why don't all the plants grow and bloom at the same time?
6. What role do plants play in the geologic processes that are active on Padre Island? [They stabilize sand to reduce or prevent its being moved by wind.] Is this role important? What would happen if the plants were eliminated from the island or torn up by cars being driven over them?
7. Use the simplified key to identify some of the plants found at Bird Island Basin. Start at the boat launch area and work toward the willow trees. [**Directions for using a dichotomous key**: The key is composed of a series of either-or choices. Select the choice that best fits the plant with which you are working and move to the number indicated by that choice. For instance, choice pair 1 asks if the plant has woody stems. If it does, you are referred to choice pair 2. If it does not, you are referred directly to choice pair 4 and you should skip all pairs before 4. If we use the sea oat as an example, choice 1 would be "does not have woody stems." You would go directly to 4. The choice in pair 4 that best describes the sea oat is "Plant grass-like with long, narrow leaves . . . . . "; this refers you to pair 6. The best description in pair 6 is "leaves up to 3 feet tall, flat in cross-section," which identifies the plant as the sea oat.]

Camphorweed

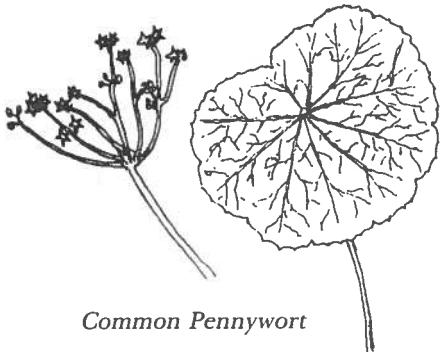


Partridge Pea



Beach Evening Primrose

Black Willow



Common Pennywort

dichotomous key

1. Plants have woody stems. 2
1. Plants do not have woody stems 4
   2. Plants grow taller than 5 feet, leaves are long and narrow, plant is tree-like . . . . . *Black Willow*
   2. Plants low growing, rarely taller than 2 feet 3
3. Plants are deciduous (lose their leaves), leaves when present fern-like, compound. Seed pods pea-like, splitting along seams to release seeds . . . . . *Partridge Pea*
3. Plants evergreen, leaves lance-shaped and in clusters near the ends of the stems. Color light green. Flowers when present 4-petaled, yellow . . . . . *Evening primrose*
   4. Plants grass-like with long narrow leaves growing from ground level 6
   4. Plants not grass-like 5
5. Leaves circular with scalloped margins. Stem attached to center of leaf . . . . . *Common pennywort*
5. Leaves lance-shaped, stiff, bright green and sharply toothed. Flowers, when present, yellow and many petaled . . . . . *Camphorweed*
   6. Leaves up to 3 feet tall, flat in cross-section. Seed heads, when present, large and showy, up to 5 feet tall . . . . . *Sea Oat*
   6. Leaves triangular in cross-section, rarely more than 2 feet tall. Flowers and seed heads drab, flowers resembling seed head. Seed head seldom more than a few inches taller than leaves, never large and showy . . . . . *Sedge*

Camphorweed may not be abundant during winter months and you may have to search to find it.

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notes:

Purpose: To make the student aware of the many invertebrates in the world and how they affect our lives.

Equipment: Field guides to insects, spiders, shells and marine organisms
Pencil and paper

Challenge: Discover as many different invertebrates as possible and learn their value to the environment and to mankind.

Guide: Invertebrates are those animals that don't have backbones or spinal cords. This group includes many of the creatures that we see most often in our lives—insects, spiders, worms and others. Most invertebrates that live on land have stiff exoskeletons or outer shells that protect their bodies from damage and provide support that enables them to move about. Some of the members of this group that we consider to be dangerous are scorpions, spiders like the black widow, and jellyfish like the sea nettle. Most members of this group are beneficial to us—the honey bee provides us with honey and fertilizes flowers so that we may have fruit. There are many other invertebrates and you will surely see some on your field trip.

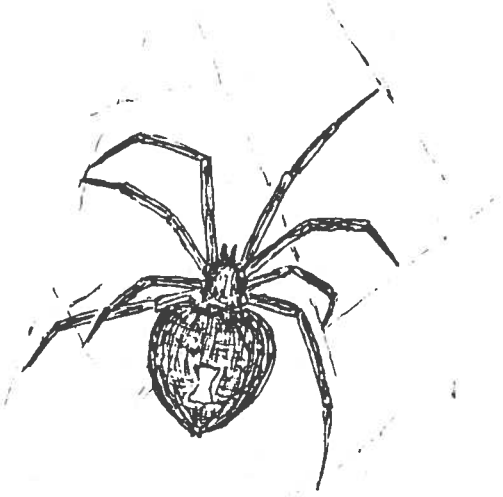
Key Words:
invertebrate
exoskeleton
pupa
venom
filter feeder
backbone
egg
adult
scavenger
tentacle
spinal cord
larva
metamorphosis
species

1. **Insects**: There are more than one million different kinds of insects in the world. Keep count to find how many different kinds you see today. Insects hatch from eggs and go through several changes in form (metamorphosis) before they become adults. [There are one or two intermediate stages, a larva stage where the insect is active and seeking food and, in many species, a pupa stage where the insect is enclosed in a cocoon while it changes from a larva to an adult.] Choose one kind of insect and try to find all the stages that it goes through in the field. [Look for eggs, dried exoskeletons, etc. You will probably not be able to find all stages of an insect in the same field trip unless the insect breeds very rapidly and several times in a season.]
2. Find the following insects:

ant lion	termite
mosquito	lacewing
ant	dragon fly
bee	grasshopper
fly	

What do they eat? What eats them? Where do they live? What identifies insects as different from other invertebrates? [Insects have 6 legs as adults. Note that the ant lion is the larva of the lacewing.]

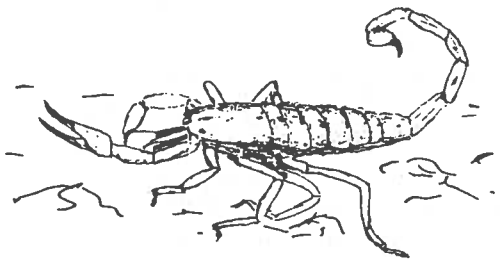
3. **Spiders**: There are many kinds of spiders in the world. Essentially all spiders eat other small animals and some have learned to dive under water to catch their food. There may be one million spiders in a grassy field the size of a football field. Where do spiders make their homes? What kinds of homes do spiders build [there are many different types of webs and some make burrows]. How are spiders beneficial to man? [They eat billions of insects and help in controlling insect pests.] What would happen if all the spiders in the world were killed? [We would be overrun by insects in a matter of only a few days.]
4. Watch a spider and write down what it does. How many animals does it eat? What kinds of animals does it eat? How do spiders capture their food? Are spiders poisonous? [Yes] Are spiders dangerous [only two species in North America]. Spiders are interesting animals to keep in the classroom and they are easy to feed and care for. The biggest problem is to provide enough food to keep them healthy. If you wish to have a spider in a terrarium, select a species that builds a web for gathering food and place it in a container that can be sealed. A glass one-gallon jar or a small aquarium with a lid taped in place will make an ideal home. Feed the spider insects or other small animals, being careful to provide food about the same size as or smaller than the spider. (Do not select the black widow or brown recluse spiders since they can give a dangerous, or even fatal, bite.)
5. Scorpions are small animals that are closely related to spiders and that have long tails



Spiders such as the black widow eat insects and other small animals.

that curve over their backs (the tail is actually part of their abdomen rather than a true tail). The scorpion uses the sting on the end of its tail to capture food. Unfortunately, it will also sting animals that threaten it. Scorpions are active at night, but may be found during the day under logs or trash. Sometimes they will spend the day under the loose bark of trees. What does the scorpion eat? [Almost any animal smaller than it is.] Is it valuable to man? [Yes] Why? [Scorpions feed on the insects that we find to be pests and help to keep insect populations in control.]

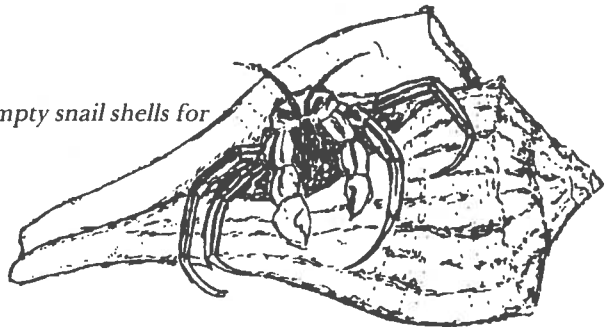
6. Centipedes don't really have 100 legs—it just seems that they do. We sometimes find these animals crawling about in the early morning in search of food. Some centipedes can bite and inject a venom that is very painful, but they are not really dangerous [to most people; the bite of some species may be dangerous to an infant or to someone who is allergic to the venom]. The centipede's legs are not poisonous. [Repeat the questions that were asked about spiders. Large centipedes also make interesting terrarium animals and may be fed any kind of insect or even small lizards or newborn mice. If you wish to keep a centipede, be prepared to supply an amazingly large amount of food to the animal to keep it healthy.]
7. Crustaceans are among the most commercially valuable of the invertebrates. We find an abundance of many crustaceans in the waters of the Laguna Madre. The blue crab is abundant, as are a number of smaller crabs. [The blue crab is the crab that we eat.] Hermit crabs are neat animals that live in cast-off snail shells. They don't have a complete shell of their own and must use the snail shell for protection. As they grow, they move into new and larger shells. Nearly all of the crabs that may be found at Bird Island Basin are scavengers, but the blue crab will attempt to catch smaller animals or fish and the stone crab will eat molluscs.



The scorpion can deliver a painful sting with its tail.

Shrimp are also crustaceans and they may be found in abundance in the Laguna's grassbeds. The most common shrimp in this area, which is less than an inch long, is called the glass shrimp because its tissues are as transparent as glass. Brown shrimp are large enough to eat or to use as bait, and they can be caught with a seine or push net in the early summer. Other crustaceans are found on land—the fiddler crab digs burrows at the edge of the water and the ghost crab is found nearly everywhere on the island during the summer. The sow bug that is found in abundance in Corpus Christi is also a crustacean.

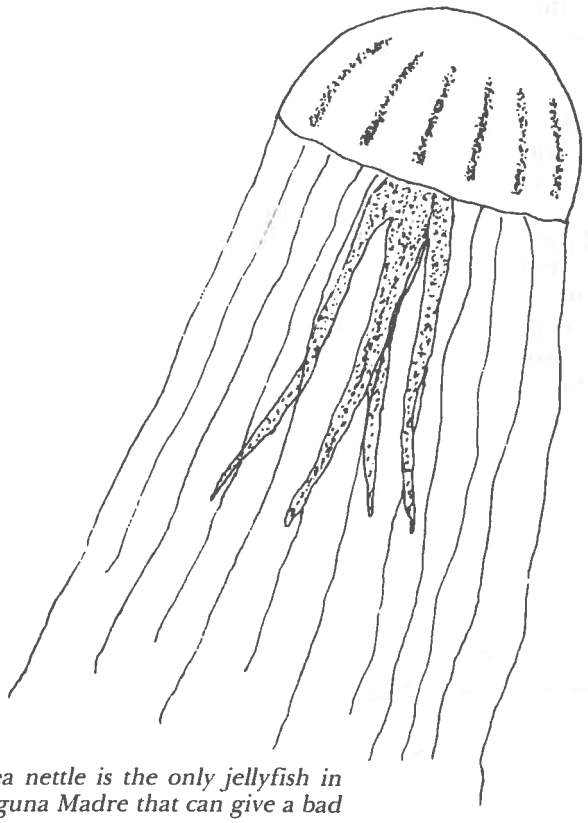
8. Molluscs are the group of animals that manufacture the seashells that are found on the beaches and in the water. The types most frequently found near Bird Island Basin include the gastropods [stomach-foot; snails], the bivalves [animals that have two shells that close on each other; clams and scallops], and cephalopods [head-foot; squid and octopus]. The cephalopods are uncommon to rare in the Laguna Madre because the water is too warm and too salty for them, but you should find a number of different bivalves and gastropods in the shallow water or in the grass beds. Molluscs are an important source of food for us. Name some of the molluscs that we eat [scallops, oysters, clams, snails, octopus, squid]. What other values do molluscs have? [Fish bait, shells for decorations or jewelry, provide food for some of the other animals that live in the oceans or lagoons]. Collect as many different kinds of shells as you can find. Identify the types of animals that live in them. Are these the animals that built the shells? Or did they simply move into the empty shells for protection? You may keep any empty shells that you find, but please release the shells that have living animals in them.
9. Other invertebrates are found in many places on the island. Worms are often found in the Laguna Madre or in other bodies of water. Marine worms come in all sizes and shapes; some even build their own shells. Jellyfish swim through the water or float on the surface and can be found at any time of the year although they are most common during the summer. How do these animals find food? [Most clams are filter feeders, but most snails eat vegetation or other shellfish. Some are scavengers. The cephalopods are hunters and eat fish, crustaceans or



Hermit crabs use empty snail shells for protection.

other molluscs. Worms often filter microorganisms from the water. Jellyfish may feed on microorganisms or on small fish which they catch in their tentacles.] What role do they play in the environment? [They are an integral part of the food chain. All are eaten by some other creature and all feed on other life forms. As they die and decompose, they provide nutrients for the plants that grow in the water. The plants, in turn, are food for shrimp, snails, fish or even sea turtles. Larger animals eat these creatures. The invertebrates also help to decompose the animals and plants that die in the water. Some, such as the jellyfish, feed on fish and help balance the populations of other animals in the environment.] Make a list of as many different invertebrates as you can find. Discuss how these creatures are the same or how they are different.

10. Make a class collection of shells and display it in the classroom. Challenge students to learn about one kind of shell in the collection and give a report to the class about that animal. [Emphasize how the animals live, what special adaptations they have for survival and why they are valuable to us.]
11. If you have a fishing license, collect a variety of invertebrates such as scallops and crabs. Discuss the importance of each for food. Cook the shellfish and give each person in the class an opportunity to taste. Scallops and oysters also may be eaten raw.



The sea nettle is the only jellyfish in the Laguna Madre that can give a bad sting.

Purpose: To teach the class about the diversity of life in the Laguna Madre, to examine adaptations of the life forms to their specific habitats, and to better understand the interdependence of all life forms.

Equipment: Hand lens
Minnow seine
Cast net
Push net
Shovel
Swim mask(s) or other device(s) such as glass-bottomed box(es) that allow one to see through the water's surface
Sieve with ¼ inch mesh (others with smaller mesh optional)
Large plastic bucket or other containers (to place creatures discovered until they are released back into the Laguna Madre)

Depending on which activity you plan, much of this equipment may not be needed. You may also want field guides to fish, shells and sea life.

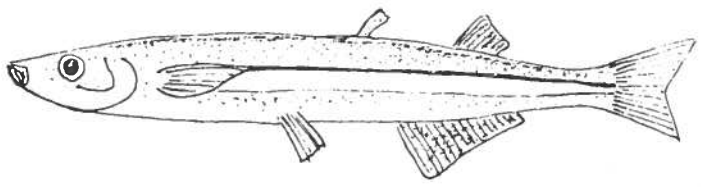
Challenge: To discover the variety of life forms that live in the shallow water near the shore and the distribution of these life forms in their habitat.

Guide: Participants should be prepared to wade at least knee deep. We recommend that shoes be worn to prevent cuts from shells or litter. Select the location where you will do the work and place water-filled buckets near the shore where the creatures that you catch can be quickly transferred from the seines or nets to the buckets. The best work areas are marked on the map.

To seine, carry the net into the water to a depth of about 2½ feet, proceeding in such a manner as to disturb the area as little as possible. It is helpful if you lift the seine above the water and if you pull it to shore in a different line from where you carried it out. Hold the seine poles lightly against the bottom with the lead weights of the seine resting on the bottom. Angle the poles so that the bottoms are toward the direction that you will be moving. It is essential that the seine be kept on the bottom—most creatures will escape under the net if there is room. Select an area where the distance to be seined is short, perhaps not more than twice or three times the length of the net. Longer pulls allow the fish to escape around the edge of the seine.

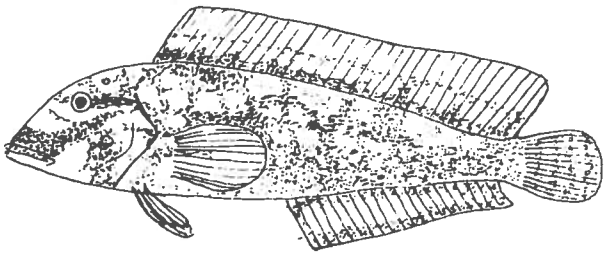
If you use sieves, place the material to be sifted or washed into the sieve. Pour water through it to remove sand—the finer the sieve the longer this will take. Wash the materials in a location where the washings won't settle back into your work area. The finer the mesh, the more you will recover. Washing through two or more sieves of successively finer mesh will recover most creatures, but such thoroughness is not necessary.

Key Words:
adaptations
shoal grass
diversity
algae
seine
habitat



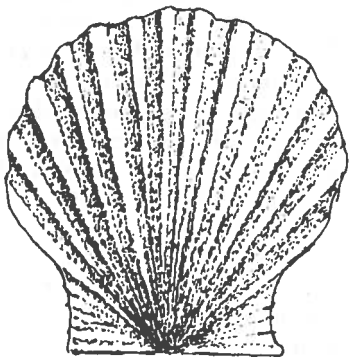
Tidewater Silversides

1. Seining—
   Pull the net where there is live shoal grass.
   Pull the net where there is live algae.
   Pull the net over bare bottom (no vegetation).
   Pull the net to shore from a depth of 18 inches.
   Pull the net to shore from a depth of 3 feet.
   Discuss the differences in the numbers and kinds of creatures that you catch. [Remember, in some instances the fish will swim out of the net before it reaches shore.] What do these differences tell you about habitat requirements? [Each living organism has needs that must be met in its habitat in order for the organism to survive. No living organism will remain in a habitat that is not suited to its needs.] Check for animals on pilings, under debris on the bottom, and in living algae. Are the animals that you find here the same as those that you captured with the seine? Why or why not?
2. Use a shovel to dig a hole in the bottom under about 6 inches of water. Make the hole about 2 feet square and about 6 inches deep. Wash the material that you remove through a sieve. If you use more than one seive, select different sizes of mesh to improve your recovery of animals. Place all animals that you catch into a container of water so they can be released at the end of the exercise. Deepen the hole in stages to 12 inches, 18 inches and 24 inches, washing each layer through the sieve. What forms of life do you find in each layer? Why do deeper layers produce fewer species? [Deeper layers of the bottom sediment tend to have less oxygen available for respiration and less nutrient material for feeding.]



Striped Blenny

3. Wade along the shore and discover as many different kinds of living creatures as you can. Look in empty cans and bottles, under debris on the bottom, and in the plant growth in shallow water. List the creatures that you find and where you find them. When you return to the classroom, create the area where you found the animals through drawings and/or cut-out pictures. Discuss the different requirements for each life form. Assign a trip report to review life forms that you found and what they need to survive.
4. Wade along the shore and observe the bottom through a swim mask or glass-bottom bucket or box. Watch the animals that you see feed, build homes, or move about. Why is each animal where you see it? What is the advantage of using the glass-bottom box over other methods of observing? [You have better visibility and you are able to watch the creatures in their normal habitat.] Discuss with the class the reasons that you see each animal where you find it and why it is doing what it is doing.
5. Take some time to examine the grass beds closely. The "grasses" are flowering plants similar to the plants that you see on land rather than members of the grass family. They have stems that lie under the surface. Carefully dig a very small section of grass from the edge of one of the beds and wash the soil from it. What do you find? [You should find not only the underground stems and roots, but also several small clams or other creatures.] Remove a similar sample of bottom sediment from an area where there is no grass. Do you find the same things? As you seine, notice that most of the animals that you gather in the net come from the grass beds. Why? [Grass beds provide both shelter and food.] What would happen if the grass beds were destroyed in the Laguna Madre? [The bottom level of the food web would be removed and most of the other life forms that are common would become rare or would disappear.]



shoreline discovery

Purpose: To demonstrate the features of the unique shoreline habitat where land and water meet; to discover what life forms may be found there and to better understand how these life forms depend on both land and water for their existence.

Equipment: Pencil and paper
Hand lens
Field guides or identification key to plants, crustaceans, fish and mollusks (field guides are optional—the ability to identify most of the plant and animal forms to general levels will suffice)

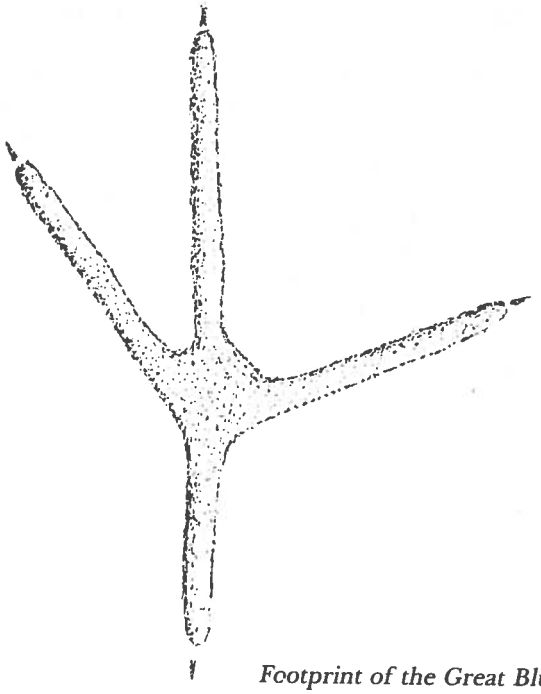
Challenge: Examine the shoreline and learn what barriers it presents to living organisms and natural forces.

Guide: The shoreline is an area of abrupt change in habitat. Because of this abrupt and significant change, few organisms can successfully live on both sides of the dividing line at the water's edge. There are a few that do make this transition, at least for short periods. These organisms include crabs, birds and some snails. The microhabitats along the shore are very interesting if you will take the time to examine them closely. Even the geology of this zone is different from the rest of the island.

Participants should be ready to wade at least ankle deep. We recommend that shoes be worn since the zone where this exercise takes place is the zone that receives the most litter. Select an area where plants grow near the edge of the water and where there is a broad shallow bottom adjacent to the shore (see map).

Key Words:
microhabitat
habitat
transition
shoreline
life form
similarity
barrier
polychaete worm
difference

1. Walk along the shore and identify as many life forms as you can. Include plants and animals both in and out of the water. Look for these same life forms away from the edge of the water. Do you find them? Why or why not? Do any life forms live on both the shore and in the water? [Some crabs may.] What effects do soils have on the kinds of life forms that you find?
2. Look at the patterns (ripples, etc.) that are visible in the sand along the shore and those that are visible just under the surface of the water. Discuss the differences and similarities between the two. [Ripples will have different shapes in cross-section and those on land will be longer than those under water. Tracks under the water tend to be erased faster than those on land. For other differences, consult a geology text or oceanography text.] What forces create these patterns? [Wind, waves, animals.] Is there a difference in the composition of the sand/mud in and out of the water? [Usually not, but there may be in some areas.]
3. The edge of the water is an area where many birds spend most of their time. What evidence of these birds do you find as you walk along the shore? [Tracks, actual sightings, feathers.] In what activities are the birds that you see engaged? [Feeding, preening, sleeping, etc.] How do these activities relate specifically to the shore?



Footprint of the Great Blue Heron

4. In the shallow water along the shore you will see many small holes in the mud. What creatures live here? [Clams, polychaete worms, others.] What happens when the water level in the Laguna Madre goes down? [The animals in the holes either move or die—many of the worms can move, but nearly all of the clams die. Discuss with the class the functions of death as a method of population control and as a method of providing nutrients for other organisms.] Is this beneficial to the Laguna? Is it beneficial to any of the creatures that live in the Laguna? [Yes] How? [The vegetation that dies provides food for the animals that feed on it. In some cases the dead animals themselves are food for crabs or some of the worms.]
5. As water rises and falls in the Laguna Madre, the exact location of the shoreline changes. How does this affect the life along the shore? [Plants may be submerged or clams may be stranded.] Can you find the high water limit by observing where plants grow? Are there ways to tell where lower water levels have been? [Yes, but they are not obvious. Look under water for plants that would not grow under water or other similar clues.]
6. Look for evidence that animals and insects hunt along the shore. Can you find it? [Look for tracks, places where birds have probed with their beaks, etc.] Why do you suppose that there is as much/little evidence as there is? [Consider removal of the evidence by wind and waves, animals hunting away from the shore and animals hunting along the shore but in the water.] What animals do you expect to hunt or live along the shoreline? [Crabs, including hermit crabs, fiddler crabs and blue crabs; many species of birds; and the larger carnivores such as the coyote or raccoon.]

food chains

Purpose: To make the student aware of how all living things are dependent on other living things for survival.

Equipment: Pencil and paper
Blank food web

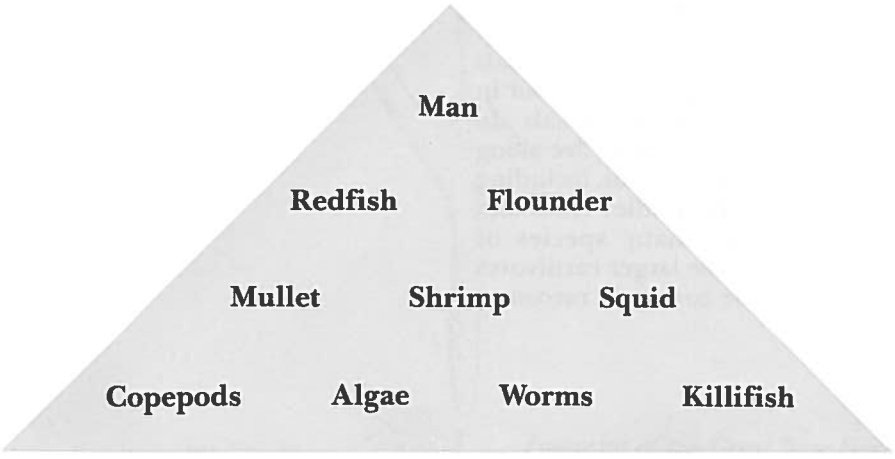
Challenge: Identify food chains and food webs in the wild; construct a simple food web.

Guide: A food chain may be thought of as a simple line of predation with a single organism at each level. For example, minnows feed on copepods. Larger minnows feed on smaller minnows. Flounders feed on the larger minnows. Humans eat the flounders. A **food web** is a more complete picture of the interrelationships of living organisms. Small minnows feed on plants and on many forms of microscopic life in addition to copepods. Small crabs feed on dead animals and on the small animals that they are able to catch. Shrimp feed on vegetation. Fish such as the flounder, trout and redfish feed on minnows, shrimp and crabs. They sometimes feed on each other also. Birds and porpoise feed on the trout, redfish and flounder. Sharks feed on the birds, porpoise and the fish. Man may eat the birds or the sharks or the fish. The interrelationships between many organisms can be followed through a food web even though they are not apparent through a simple food chain. There are a few instances where the food chain is the complete picture. The humpback whale feeds directly on the many species of pelagic minnows, shrimp and crabs. There are no intermediate levels. It still requires a food web to illustrate, however, since the minnows, shrimp and crabs are dependent on many smaller life forms.

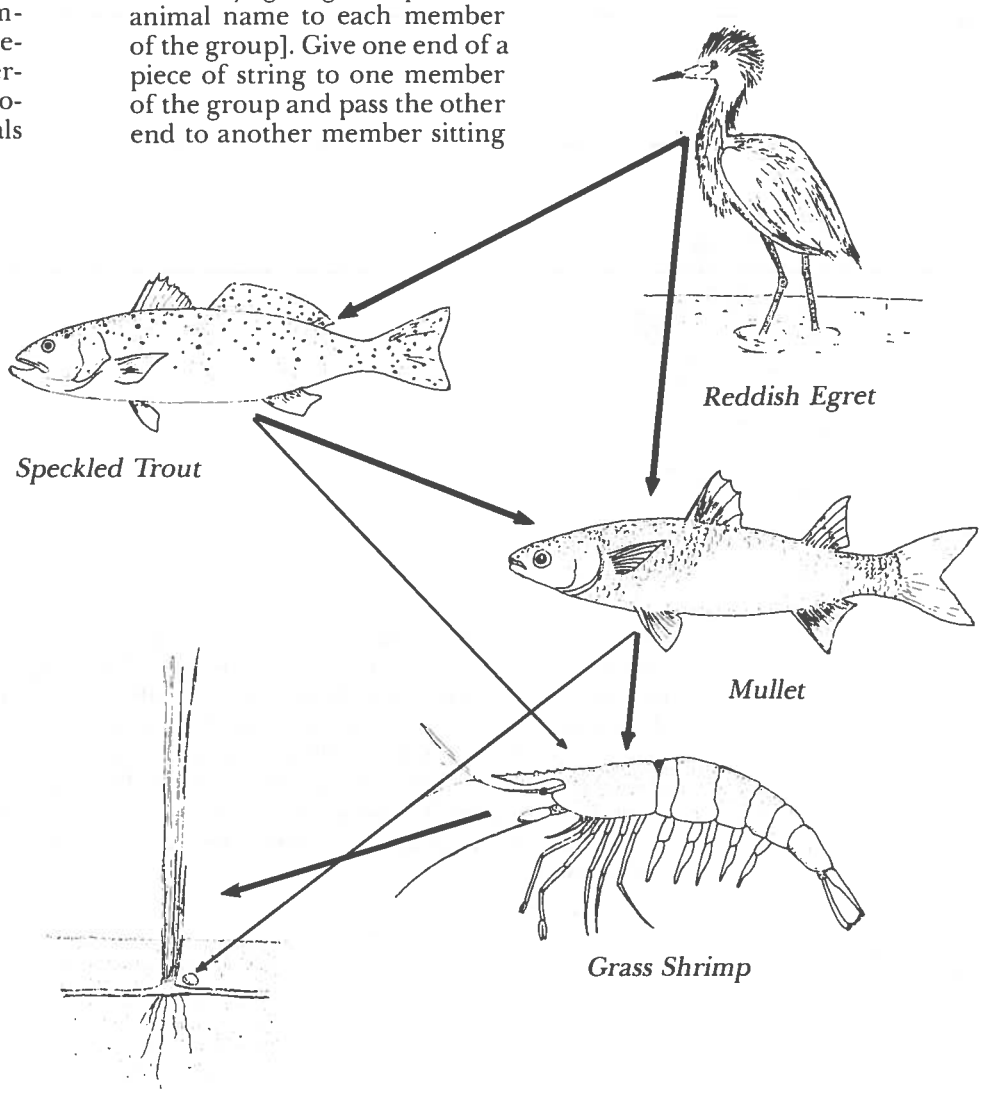
Key Words:
interrelationship
pelagic
predator
prey
food chain
copepods
species
organism
food web
predation
level (of food web/chain)

1. Discuss the food webs that occur in nature (general concept with examples). Describe for the class how food chains and food webs differ.
2. Construct a simple food web using the land plants and animals that you see at Bird Island Basin. Start the web with the nutrients that the plants use, sunlight and air, and follow it through to the highest level of predation that you see. Don't forget, humans are predators, too. Repeat this exercise for the plants and animals that live in the water. Construct a food web that includes both the land and water habitats.
3. How do numbers change as you move from one level of the food web to another? Why is this so? [Numbers decrease as you move higher. Think of the number of shrimp and minnows a whale eats every day—many thousands! If there were not many more animals at the lower levels of the web, the animals at the higher level would soon exhaust their food supply and starve.] Are there plants and animals that fit into more than one level of the web? [Yes] Which ones? [The sundew is an example. It eats some insects, but is in turn eaten by insects or other animals.]
4. Watch the insects and animals that live around the Bird Island Basin to see what each eats. Combine the class observations to create a food web. Were class observations sufficient to connect all the levels of the web? Discuss any "missing links" in the web.

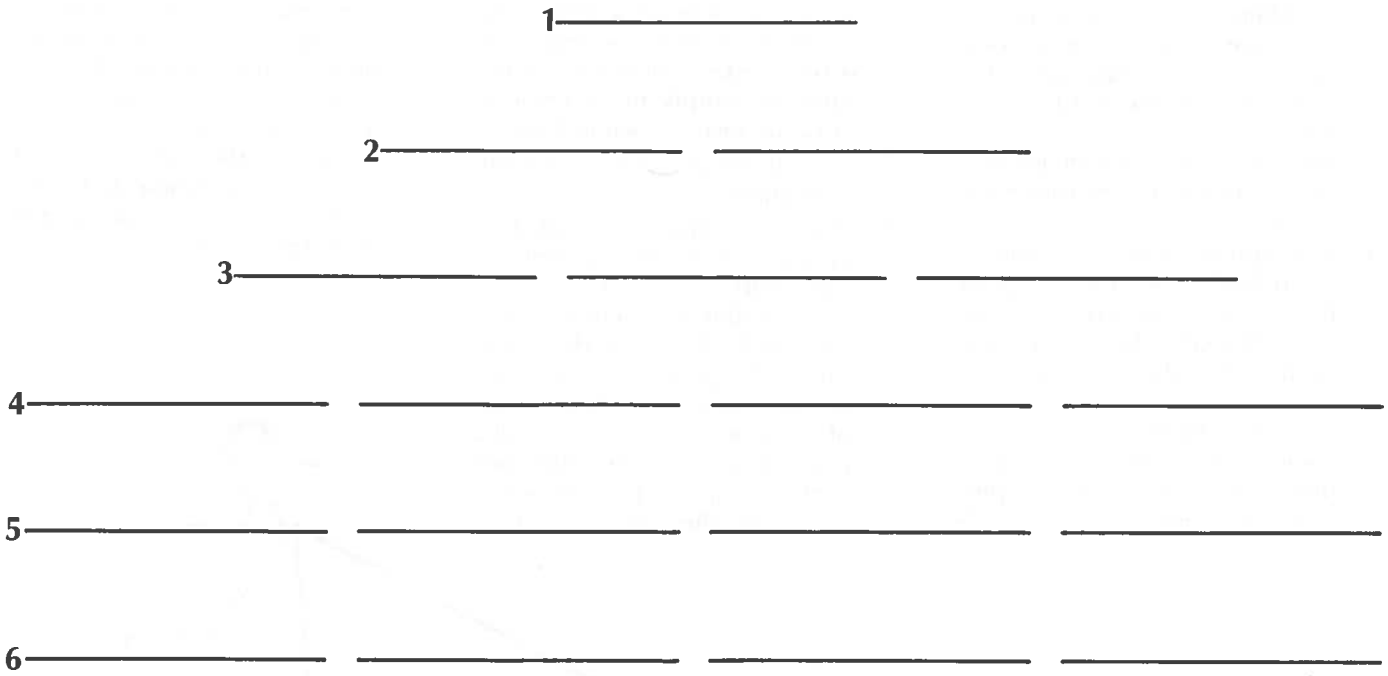
Sample Food Web



5. The sample food web shows some of the many species that may be seen in the Laguna Madre. There are other species that might be a part of this web, such as pelicans, gulls, terns, snails, shoal grass and humans. Have the class fill in the blanks of the food web activity sheet (make a copy for each student). What individual differences are there in the students' webs? Combine the students' results to create a larger, more complete web in the classroom. Discuss the organisms that were listed most often and least often. Were there any major animal or plant species that were missed?
6. It is important that we understand food webs. What happens if we remove one level from the web? [Usually the species immediately above that level starve and the species immediately below that level become many times more numerous. These population explosions often result in the animals whose populations increase depleting their food supply and eventually starving.] What happens if we remove one organism from the web? [There will be a decrease in food supply for the animals that prey on that organism and the other animals or plants that the predator feeds upon will be eaten in greater numbers. All the animals and plants suffer as a result.] Does it make a difference where the level or the organism is removed? [Not really, the results are simply more obvious or occur faster at some levels.]
7. Trace insecticides through their food chain.
8. Have the members of the group sit in a circle. Distribute cards with names of plants or animals that are members of a food web [distribute the cards randomly, giving one plant or animal name to each member of the group]. Give one end of a piece of string to one member of the group and pass the other end to another member sitting opposite the first person. Continue passing the end of the string until you have formed a closed loop (web) with the string. (Give the loose end to the person who has the other end to close the web.) Once the web is closed, instruct students to position themselves in such a way that the web is tight when each member is holding his or her loop. "Remove" one plant or animal from the food web by having that person drop the string. What happens? Remove another plant or animal. If a healthy environment is represented by the tight food web (string), what is indicated by the removal of even one species from the web of life?



Food Web



There are six levels shown on this food web. Some food webs are smaller and others may have more than six levels. Lower levels may also have more than four species in the level (each blank should be a single species such as "redfish" rather than a general group like "fish.") Each level is important to all of the levels above it. What happens if level 3 is removed? What happens if one plant or animal is removed from level 3? How does man influence your food web by hunting or fishing? Is man a part of your web?

Purpose: To introduce the class to birdwatching, some aspects of the life of birds, and to the importance of Padre Island to the bird populations that frequent this area.

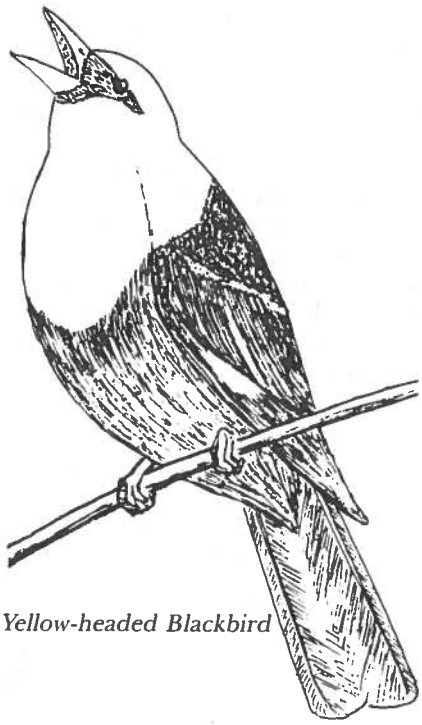
Equipment: Binoculars are desirable
Field guides to birds with aids to identification
Checklists of birds*
Notepaper and pencil
There should be at least one pair of field glasses for each two students. If a high-power spotting scope is available, the group may be able to see and identify more species.

Challenge: Identify as many different bird species as possible, relating each species to its environmental adaptations, food type and nesting activities.

Guide: Padre Island and South Texas are some of the best locations in the United States to watch birds. More than 350 species of birds can be seen during the year, and some, like the green jay, are found nowhere else in the United States. The best birding is normally during the spring, but winter is a good time to observe waterfowl. Before you make your trip, discuss the different birds that you expect to see, where students should look for specific kinds of birds, and why they should expect to seem them there.

Key Words:
species
competition
field mark
waterfowl
bird of prey
song
shore bird
raptor
call

1. Identify as many different kinds of birds as you can. Be sure of your identifications. Discuss the field marks that may be used to identify different bird species.
2. Observe and describe five different ways of feeding that you see birds use. How do these different methods of feeding make it easer for the birds to find food? [Reduces competition.] What foods do they eat? How do their beaks help them feed?
3. Watch the feet and legs of the birds or find their tracks. What differences do you see? [Watch for toe position, claws, webbing.] Why would these differences be important to the birds? [Support on soft ground, use of feet to capture prey, swimming, perching, etc.]
4. Find males and females of the same species of bird. Are they colored the same? [Yes for some species, no for others.] Is this true throughout the year? [In most cases, it is.] Why do you think the birds are colored as they are? Why are different types of birds colored so differently from one another? [species identification]
5. Listen to the songs or calls of as many species of birds as you can. Are they different? Why? [species identification] Do birds that are closely related (such as herons and egrets) have calls that are more similar than birds that are not? [Usually, but not always—compare the calls that you hear.]
6. Using a map that shows the migration routes of birds, note the large numbers of species that cross Padre Island and south Texas during migration. What factors make this area important to these birds? [Supplies of food and water, resting places. Find other factors to discuss with the class.]



Yellow-headed Blackbird

The bill of the long-billed curlew allows the bird to probe deep into the ground for insects or other small animals.

adaptations

Purpose: To illustrate how plants and animals are able to adapt in order to survive the harsh environment on Padre Island and learn some of the physical conditions that affect plants and animals from day to day.

Equipment: Pencil and paper
Magnifying lens
Thermometer for measuring soil temperatures

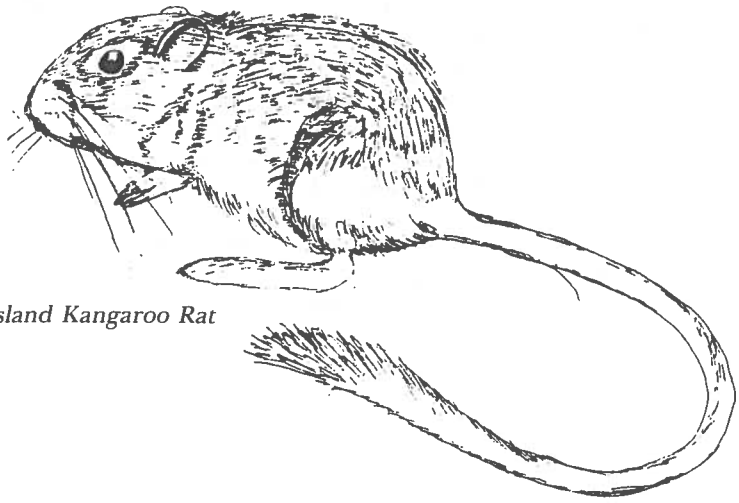
Challenge: Find as many adaptations that plants and animals have made to the environment as possible. How does each adaptation benefit that plant or animal in its struggle for life?

Guide: There is very little shade available on Padre Island for such large creatures as humans or coyotes. Shade is plentiful for smaller animals. Most creatures that live on the island are able to live and function only within a narrow range of temperatures. In summer, most of these are active at night or in the early morning and late evening when temperatures are moderate.

Animals adapt to their environment in different ways. Some evolve protective coloration. Others have modified their behavior to increase their chances for survival. One of the most interesting adaptations is the kangaroo rat. This neat little animal is very well adapted to the desert (or lack of fresh water). It may never take a drink of water during its entire life! Its main food is the seeds that may be found on the island. It will gather the seeds at night when it's cool. It stores the seeds underground until they have absorbed as much moisture from the soil as they will hold. The rat then eats the seeds. This animal has very efficient kidneys and it excretes virtually no liquid urine. It is thus able to live on the small amounts of water that it obtains from its food.

A behavioral adaptation is illustrated by many of the reptiles. If a rattlesnake is left out in the sun during the summer heat, it will die of heatstroke in only a few minutes. During summer, they avoid sunlight or are active at night. During the winter, however, the same snake may seek sunshine to warm itself before it hunts for food. By selectively using sunlight and shade the snake can control its body temperature and survive in this harsh environment.

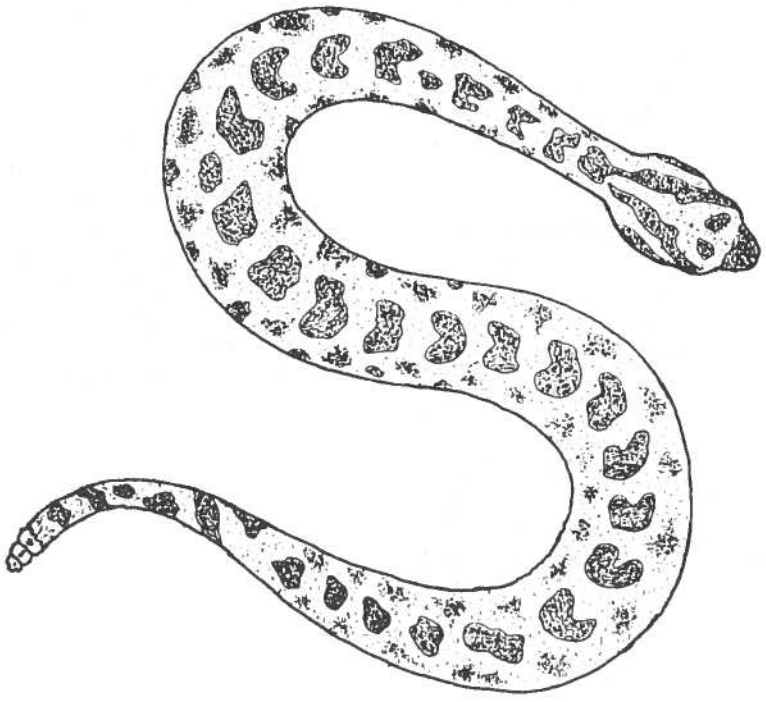
Key Words:
adaptation
metabolism
soil temperature
evaporative cooling
predator
survival
temperature
environment
behavioral adaptation
protective coloration
solar energy
behavior



Padre Island Kangaroo Rat

1. Spend a few minutes in the bright sunlight. While you are there, record the kinds of plants and animals that you see in the sun. Move into the shade and repeat the exercise. Are there differences? [There should be. Also, look for seasonal differences.] How do you react to the change between sun and shade? Where might small animals find shade if there are no trees or other shelters around? [Under grass, dig burrows, etc. Coyotes and raccoons also dig burrows or dens to escape from the daytime sun.] Do plants use shade? [Yes. Notice that some plants are found growing only in the shade of the willows or are more abundant in the shade of the willows.]
2. Measure the temperature of the surface of the sand in bright sunlight. Let the thermometer remain in place for 2 or 3 minutes to record the temperature accurately. Measure the soil temperature 1 inch below the surface, 3 inches below the surface and 6 inches below the surface. What differences do you find? [Temperature should decrease as you go deeper below the surface.] Repeat this process in the shade. Measure the air temperature 4 feet above the ground in open shade. How do soil temperatures compare with air temperature? [Surface temperature should be significantly higher. The air temperature is measured in the shade because sunlight falling directly on the thermometer will heat it.] What does this exercise tell about the reasons many creatures live above the surface or underground?

   Carefully pour about a gallon of water onto the sand in the open sun and in the shade. Allow the water to soak in, then wait for a few minutes. Measure the temperatures on the wet areas as you did previously. How does water affect the solar energy absorbed by the soil? (Don't forget to consider evaporative cooling.) How might soil moisture be a factor for adaptation in animals? In plants?
3. Select some adaptations that are easy to find and describe them to the class. Grasshoppers are often seen in this area and they come in two colors, tan and green. The tan ones stay on the sand or dead vegetation, while the green ones live on green vegetation. This adaptation hides the insects from predators and helps them to survive. Have the students make a list of as many adaptations as they can and their values to the plants or animals.
4. Has man adapted to the island or has he tried to adapt the island to his own needs? Discuss this and what effects the adaptations will have on the island and the animals that live here in the next hundred years.



humans in the environment

Purpose: To provide some specific examples of human interactions in the natural environment.

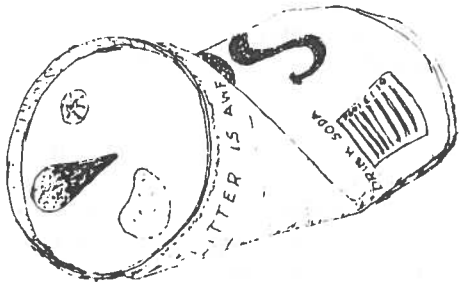
Equipment: Other than that listed in individual exercises, an awareness of humanity as a part of nature and the environment.

Challenge: Relate and identify the role of humans in the environment, the ways that humans influence the environment, and the dependence of mankind on a clean and stable environment.

Guide: The influence of humans on the Bird Island Basin area is obvious in some places, but very subtle in others. Most of the oyster shell that is present around the boat launch area and the willow trees has been put there through human activity. Roads and parking areas are, of course, obvious. Less obvious is the change of habitat that human presence has caused. As you work through the exercises below or through some of the others on other subjects, describe for the class how humans have influenced the environment.

Key Words:
erosion
food chain
long-term effect
environment
algae
exotic
species
evaporate
interact

1. What changes have the hard surface road made in the local environment? [A change in run-off pattern for rain water which has changed the kinds of plants that grow in the area.] What evidence do you find that nature is trying to reclaim this area? [Moving sand dunes, plants encroaching on facilities, shoreline eroding.] What must be done to keep the area as it is for human use?
2. Behind the willow trees there are several places where the surface of the ground is covered with oyster shell. This shell has been brought in to retard erosion (partial reason). What evidence do you find that it has been successful? Has it changed the types of vegetation that grow in the area? [Yes. Compare with nearby area.]
3. The paved road into the Bird Island Basin area is not the original. The first road was built by oil companies to provide access to the Laguna Madre for shipping. Traces of the original road are still visible south of the willow thicket. Can you find them? What changes have been caused by the original road? [Changes in vegetation on road bed due to compaction of the soil.] Are they permanent?
4. As you seine or work along the edge of the water, you will find several empty cans or bottles and other man-made debris. What effects are these having on the general environment? There are more than you would think. For instance, the bottles and cans dropped into the water provide homes for oysters, barnacles, and serpulid worms. These creatures must have hard surfaces on which to live. Small fish species such as the blennies and gobies use the cans and bottles as homes and can exist in greater numbers in areas where there is a large amount of trash. Other creatures higher in the food chain may therefore have a larger supply of food and be able to exist in greater numbers. Discuss the possible implications of this sequence of events on the general ecology. What adverse effects will littering have?
5. Look at the mudflats. Vehicle tracks cross them in all directions. If you walk to these tracks and look at them, you will find that they are causing or have caused several changes. The tracks have broken through the algae mat that covers the surface of the flats and the moisture that would normally be held by the mat can now evaporate. Sand is collecting in the tracks and changing the surface, which is, in turn, allowing different types of vegetation to grow in this area. This change influences the kinds of animals that live or feed on the flats. What other changes have been caused by driving here? [Visual pollution, etc.] What are the long-term effects of this careless use?
6. Nearly all the islands that you see from the Bird Island Basin were created by dredging. Some of the vegetation on

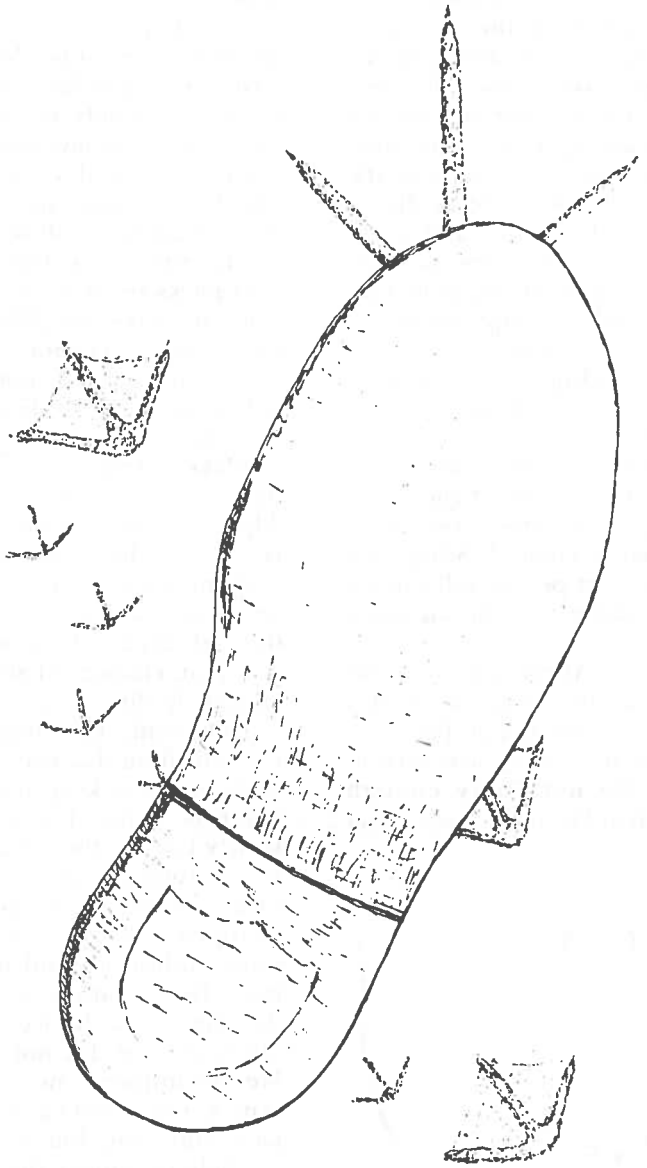


Litter occasionally provides a home for some animals.

them is exotic (not native to this area). Has this change benefited the overall environment? What creatures have benefited? [Birds, mostly.] Which may have suffered? [Animals that prey on birds' nests and birds, and animals that need shallow water to exist.] How? [There are fewer birds or eggs to eat on the main island; habitat destruction.] What will be the long-term effect of this type of human activity?

7. Identify 10 ways that humans have changed or influenced the Bird Island Basin area. Discuss each in terms of short-term or long-term change and the effects on the environment. Which of the changes require constant maintenance? Which would be permanent if man were to disappear from the area forever?
8. Divide the class into four groups and have the groups face in four different directions. Allow students 10 minutes to write down all forms of human activities that are visible or apparent in the direction that they are facing. Gather the lists and discuss the activities. What permanent changes will these activities cause?
9. Consider yourself going back in time to when there were no Europeans in North America. As you look around what differences would you see? [More trees and shrubs for instance.] How would you expect to survive? What other animals or plants might you find that are not here in the 20th Century? [Live oak, red bay, deer, javalina, cougar, ocelot, others.] Would life have been more pleasant or less so? Would there have been parts of your existence that were more pleasant while others were harder?
10. Discuss the effects that man in other parts of the world might have on the Laguna Madre. The exhaust from industry and automobiles increases the amounts of acid and lead that finds its way into the Laguna. Burning of toxic wastes in the Gulf of Mexico may put toxic byproducts into the Laguna through rainfall. The oil spill that occurred after the Ixtoc I well blow-out in 1979 covered Texas beaches with oil. If some very specific measures had not been taken by the Coast Guard and other agencies, much of that oil would have found its way into the Laguna and other bays along the Texas coast. Find other examples of the effects that man has on the environment at great distances.

As you engage in other exercises suggested in this guide, please keep the concept of human interaction with the environment in mind. When possible, discuss the exercise with the class in terms of humans in nature, both as a part of nature and as beings set apart from the environment.



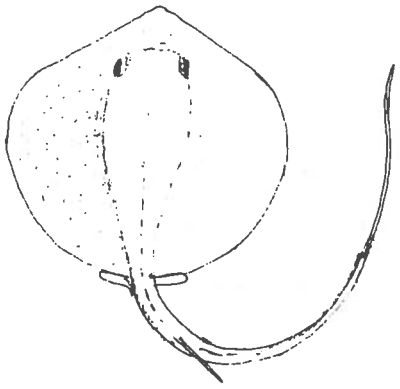
While we don't anticipate that there will be any need for first aid, we find that it is always wise to be prepared. There are a number of possible minor injuries that may happen in the Bird Island Basin area. The basic treatments for these are given below.

Jellyfish stings: Stings are caused when tiny stinging cells called nematocysts are triggered and inject a powerful venom into the skin. Because of the microscopic amounts of venom injected, usually the most important symptom is a painful sting. An extremely severe sting may cause other problems on rare occasions.

Treatment: Wash the sting with rubbing alcohol (if available) or with water. Make a paste of unseasoned meat tenderizer and alcohol (or water) and apply it to the sting. Papain, an enzyme found in the tenderizer, works specifically to break down the venom and it will relieve the pain in a few minutes for most people. If the pain persists, or if other symptoms occur, seek medical treatment.

Stingray stings: The stingray doesn't really sting. Instead, it jabs with a sharp, bony spine that is covered with a mild venom. The most dangerous part of the stingray sting is the deep puncture wound that is created. Stings can be prevented if people will shuffle their feet along the bottom when wading.

Treatment: Apply heat—hot water at about the temperature of a hot bath, chemical hot packs or other similar sources are recommended. **Do not apply enough heat to burn.** We recommend that victims see a doctor to be sure that the wound is properly cleaned and that the tip of the spine is not left in the flesh.



The Atlantic stingray lies on the bottom under a thin layer of sand.

Insects, Spiders, Scorpions, Centipedes: While there are some scorpions, centipedes and venomous spiders within the National Seashore, human contact with these creatures is extremely rare. Much more common are the stings of insects including ants, bees, wasps and the asp caterpillar. First aid for these is simple. Examine the sting to see if the stinger is still present. If it is, carefully scrape the skin to remove it. Do not squeeze it—squeezing will inject more venom. Wash the sting with alcohol and meat tenderizer as described for jellyfish stings or use the commercially prepared "sting kill" swabs to relieve the pain. Scorpion stings and centipede bites may be extremely painful and the above treatment will be only slightly effective. Pack these stings in cold packs or in ice wrapped in a cloth and take the victim to medical treatment. Do **not** apply heat to these stings, and do **not** give internal or injected medication to reduce pain.

Snakes: Two species of rattlesnakes are found on Padre Island. These are the only two dangerous reptiles on the island and they are seldom seen away from dense vegetation. If you lead the group through areas where you can see the sand, chances of snakebite are extremely slim.

Treatment: The single most important thing that can be done for snakebite is to keep the victim absolutely calm. Have him walk **slowly** back to the vehicle or carry him to transportation. Application of a chemical cold pack or ice wrapped in a cloth is suggested by some authorities and may reduce pain. Do **not** apply ice directly to the skin or use dry ice. Do **not** add salt to the ice. Do **not** apply heat. We recommend not cutting the skin. Cutting will cause additional pain and fear, but will probably not help to remove the venom. Do **not** suck the bite with your mouth. Transport the victim to a hospital at normal highway speeds. Death in an automobile accident is much more likely than death by snakebite and even a minor accident will delay your arrival at the hospital.

Head of a centipede.

Sunburn: Sunburn is probably the most common first aid problem that we encounter in the National Seashore. Protection is the best remedy and this can be accomplished by keeping exposure to the direct sun to a minimum. The white sand and water on the island reflect the sun's rays and people tend to burn faster than they realize. For mild sunburn, commercially prepared ointments will relieve pain and help healing. Commercial lotions and sun screens also prevent or reduce burn. For severe sunburn we recommend that you seek treatment from a physician.

Other first aid problems are very unusual. Basic first aid training through the American Red Cross will prepare you to deal with most of the situations that you will encounter. For further assistance with injuries, go to the Ranger Station (open 8 a.m. to 4:30 p.m. daily).

Carolina Biological Supply Co.
2700 York Road
Burlington, N.C. 27215
(800) 334-5551
[Catalog available on request]

Fisher Scientific
10700 Rockley Road
P.O. Box 1307
Houston, Tex. 77251
(713) 495-6060
[Catalog available on request]

Althor Products
Division of American Hinge Corp.
496 Danbury Road
Wilton, Conn. 06897
(203) 762-0796
[Catalog available on request]

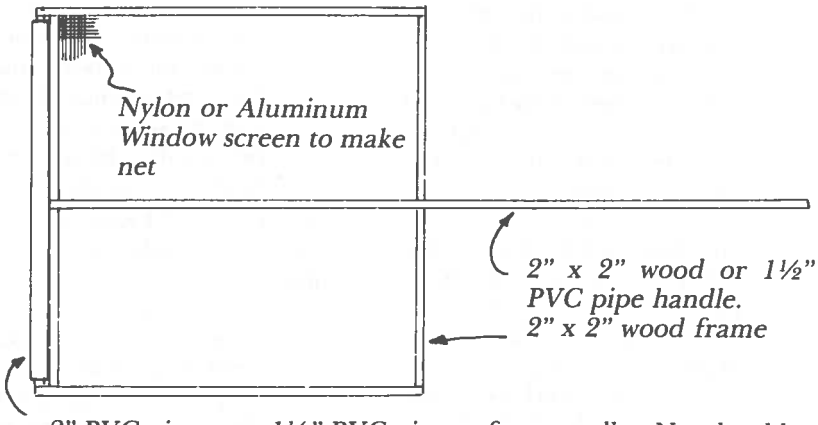
VWR Scientific
P.O. Box 33348
Houston, Tex. 77033
(713) 641-0681
[Catalog available on request]

Seines and cast nets can be purchased at most fishing equipment stores in the Corpus Christi area or they can be ordered from Carolina Biological Supply Company.

Sieves can be ordered or they can be made by:

1. using a large tea strainer
2. attaching a window screen or hardware cloth to a wood frame
3. clamping a window screen or hardware cloth to a tin can which has had both ends removed. A hose clamp will hold the screen securely in place.

Five-gallon plastic buckets can be acquired from many hamburger restaurants for a nominal cost. Other types of containers can be ordered from the suppliers listed. Push nets can be manufactured or purchased.



Push Net Construction

Exerpts from Title 36, Code of Federal Regulations
Parks, Forests and Public Property

Paragraph 2.1 Preservation of natural, cultural and archeological resources.

(a) Except as otherwise provided in this chapter, the following is prohibited:

(1) Possessing, destroying, injuring, defacing, removing, digging or disturbing from its natural state:

(i) Living or dead wildlife or fish, or the parts thereof, such as antlers or nests.

(ii) Plants or the parts or products thereof.

(iii) Nonfossilized and fossilized paleontological specimens, cultural or archaeological resources, or the parts thereof.

Paragraph 2.1 (c)

(1) Since the presence or absence of unoccupied seashells and other natural and man-made objects, including lumber and driftwood washed in by the tides on the National Seashore beaches, does not affect the Park's wildlife, plant life or other natural resources to any discernable degree, the collection of these items by persons for their personal use is allowed. Man-made objects of obvious value must be handled as found property under 2.22 (c).

(2) [This paragraph may be interpreted to allow collection of very small samples of sand or sediment, not to exceed an ounce or so.]

Official Designations Pursuant to Requirements of 36 CFR, Parts 1, 2 and 3; October 3, 1983.

Paragraph 2.2 Wildlife Protection

(a) The following are prohibited:

(1) The taking of wildlife, except by authorized hunting and trapping activities conducted in accordance with paragraph (b) of this section.

(2) the feeding, touching, teasing, frightening or intentional disturbing of wildlife nesting, breeding or other activities.

(b) A specimen collection permit may be issued only to an official representative of a reputable scientific or educational institution or a State or Federal agency for the purposes of research . . .

Paragraph 2.5 Research Specimens

(a) Taking plants, fish, wildlife, rocks or minerals except in accordance with other regulations of this chapter or pursuant to the terms and conditions of a specimen collection permit is prohibited.

(g) Specimen collection permits shall contain the following conditions:

(1) Specimens placed in displays or collections will bear official National Park Service museum labels and their catalog numbers will be registered in the National Park Service National Catalog.

(2) Specimens and data derived from consumed specimens will be made available to the public and reports and publications resulting from a research specimen collection permit shall be filed with the Superintendent.

Paragraph 2.2 Property

(a) The following are prohibited:

(3) Failing to turn in found property to the Superintendent as soon as practicable.

(c) Disposition of property.

(1) [Property] shall be deemed to be abandoned unless claimed by the owner or an authorized representative within 60 days. The 60-day period shall begin when the rightful owner has been notified . . . , or from when the property was placed in the Superintendent's custody . . .

(2) Unclaimed, found property . . . may be claimed by the finder, provided that the finder is not an employee of the National Park Service.

acid—a donor of hydrogen ions; a material that substitutes hydrogen for other metals.

adaptation—a change in behavior, color, shape, or other characteristic in response to environmental or other stimuli or pressures.

adult—The stage of an organism in which it is able to reproduce its own kind. The final form of those organisms that change forms as they grow and mature.

algae—Single celled plants capable of manufacturing food through photosynthesis and existing either as isolated cells or, more commonly, as colonies. Algae colonies are characterized by their total lack of vascular tissues.

alkali—a receptor of hydrogen ions; a material that combines readily with hydrogen or removes hydrogen from other compounds. Alkalis are characterized by a slick, soapy feel.

angle of repose—the maximum slope that a deposit of loose material such as sand or gravel can maintain without support and without sliding.

annual—a plant that completes its entire life cycle in one growing season.

backbone—the series of vertebrae forming the bony support/connection between the fore limbs and hind limbs of an animal.

barrier—any natural or man-made feature that stops a series of events from happening. One example is a body of water stopping the movement of land animals as they migrate.

bark—the outer covering of the stem of a plant, corresponding to the skin of animals.

behavior—the actions of an animal, either as a result of instinct or in response to an outside stimulus.

behavioral adaptation—a change in behavior as a direct result of a specific stimulus in the environment that enables the animal to survive or exist in that environment better.

birds of prey—those birds that feed on other birds or animals; the hawks, eagles and owls.

blow-out—a sand dune on which vegetation has been destroyed and which is beginning to move in response to wind and/or the natural elements.

call—the sound made by an animal or bird which does not necessarily have a repeated or "harmonious" characteristic.

carnivore—an animal that eats meat as the mainstay of its diet.

cast—the positive impression of a mold or track as a plaster cast of an animal track.

chlorophyll—the green substance in plants that enables the plants to combine water and carbon dioxide in the presence of sunlight to form sugar.

climax community—that grouping of plant species that will dominate a given habitat unless outside forces such as fire interfere.

competition—the struggle between a given group of plants or animals to obtain food, water, or other needs from a specific and limited supply.

compound—(1) a chemical combination of two or more elements. Most substances that we see every day such as water, sugar, salt, etc., are compounds. (2) multiple or made up of more than one part.

compound leaf—a leaf (like that of a fern) made up of several to many smaller blades or "leaflets."

contamination—the inclusion in a substance of an unwanted second substance.

copepod—minute crustaceans characterized by a relatively round body and life unattached to the bottom or other surface.

cross-bedding—differential deposition of sand due to the shifting of wind direction and visible in the cross-sections of dunes as line intersecting each other.

crustacean—a member of the class Crustacea; a free-living or attached animal with an outer shell and few to many pairs of legs. Most crustaceans breathe through gills.

crystal—a piece of mineral or other material in which the internal [molecular] structure is arranged in a definite and specific lattice arrangement.

crystalize—to form into a solid with a definite internal lattice structure either as a result of cooling or the evaporation of solvent; to form a crystal.

deciduous—plants that live for more than one year and shed all of their leaves during the non-growing season (usually winter in North America).

den—the dwelling place of an animal; the cave or excavated hole in which an animal lives. The term den is most often applied to the dwelling place of a carnivore.

deposition—the act of depositing. Leaving of some material in a location as in currents depositing sand on a beach.

diffuse root—plant roots characterized by many spreading branches of about equal size and lacking any single main root.

diversity—difference between species, habitats, etc.

dune—the accumulation of wind-deposited sand into a hill or mound.

egg—the single cell reproductive stage of an organism; the female reproductive cell.

element—the most basic subdivision of all materials that cannot be further divided into other substances; i.e. copper, hydrogen, oxygen, carbon, etc.

environment—the sum of natural and man-made conditions in which an organism exists. Natural environment refers to the sum of natural conditions and man-made environments usually refers to a totally artificial set of conditions as in a growth chamber. An environment may contain several or many habitats.

erosion—the removal of sediment, soil, rock or other material by wind, rain or other natural agent.

evaporate—the conversion of a liquid or solid to a gas with the absorption of heat. Many solids may not pass through the liquid stage before becoming a gas.

evaporative cooling—the cooling effect produced by the process of evaporation as a liquid absorbs heat to become gas.

evergreen—a plant that does not shed all of its leaves as a normal part of an annual cycle and that has foliage the year round.

exoskeleton—the stiff outer covering of many invertebrates like insects or crabs. The exoskeleton is

essential for support or for these animals to be able to move.

exotic—not native; imported; not naturally found to live in an area.

field marks—the characteristic markings, especially in birds, that are used to distinguish one species from another by observers in the field.

filter feeder—an animal that feeds by filtering or extracting microscopic organisms from the surrounding water.

flower—the reproductive portion of most types of plants.

food chain—the conceptual interrelationship or predator and prey on a single species basis.

food web—the conceptual interrelationship of predator and prey where the presence of several species or prey for each predator are depicted.

habitat—the physical surroundings where an organism lives; as a stream or the shore of the ocean.

herbivore—an animal that feeds primarily or exclusively on plant materials.

insectivore—A member of the mammalian class Insectivora; an animal that feeds almost exclusively on insects and other small invertebrates.

interact—for one creature/species to relate to another creature/species in such a way as to change some aspect of both creatures'/species behavior.

interrelationship—the continued interaction of two or more creatures/species in such a way that the interaction is a normal part of the environment for both creatures/species.

invertebrate—an animal that lacks a spinal cord.

island—an area of land surrounded entirely by water; one environment entirely surrounded by another environment.

larva—the juvenile active stage of an animal that differs from the adult in form or ways other than size alone.

leaf—the organ of a plant that contains chlorophyll, extends from the stem and serves as the primary organ of respiration and food production.

life form—any living plant or animal; the group of one kind of plant or animal.

littoral—moving along and parallel to the shore of the ocean as a littoral current.

long-term effect—an effect that will endure for one or more generations or for many years as opposed to a short-term effect that will disappear in a matter of a few weeks, months or a period of less than one generation.

metabolism—the chemical workings of a living organism through which it manufactures, processes or stores food and energy and rids itself of wastes.

metamorphosis—the change from one stage of maturity to another, especially from the larva stage to the adult stage.

microhabitat—the specific set of conditions in which an animal or plant lives. If a stream is the habitat, a small area of still water under a rock might be the microhabitat.

mineral—a mixture of elements and compounds to form a recognizable material with specific properties that vary within set limits. Minerals are usually thought of as specific forms of rock.

mollusc—invertebrates having specific types of respiration apparatus, symmetry, and other characteristics. For the purpose of this guide, the clams, snails, squid and octopus.

nutrient—a type of food or a specific component of food utilized or required by a plant or animal.

organism—the whole body of any plant or animal.

pack face—on a dune, the windward face where sand is driven by wind and packed into a hard surface.

pelagic—living in the open ocean and free swimming.

perennial—a plant that lives for more than one growing season either by the entire plant remaining alive (as in trees) or by the plant sprouting each season from a set of roots that remain living from year to year.

pH—the measure of the acidity or alkalinity of a solution or substance; the higher the pH, the more alkaline the solution.

photosynthesis—the process through which a plant combines water and carbon dioxide in the presence of sunlight and chlorophyll to make sugar.

plant succession—the change in the plant community over a period of time as the conditions of the habitat change.

polychaete worm—any of the marine worms having a number of bristles or "feet" along their sides.

pollination—the process of fertilizing a flower by placing the pollen [male sex cell] on the female organ of the flower so that the contents of the pollen can merge with the ova [female sex cells or eggs].

predation—The feeding of one species or another; usually reserved for use as one species of animal hunts, kills and feeds on another species of animal.

predator—an animal that hunts, kills, and feeds on another species of animal.

prey—an animal that is hunted, killed and fed on by another species of animal.

protective coloration—camouflage coloration; coloration that enables an organism to blend with its background and be less visible to predators.

pupa—the resting or "cocoon" stage of insects.

raptor—a hawk that hunts by soaring.

relative density—the weight per unit volume of one material compared to the weight per unit volume of another material.

root—the organ of a plant that serves to anchor the plant, to absorb water and nutrients from the soil and (in some species) to store food.

scat—the feces of an animal, particularly of a mammalian carnivore.

scavenger—an animal that feeds primarily by finding and eating dead animals; crabs and vultures are two types of scavengers.

sediment—sand or other material deposited by wind or water currents.

shore bird—a type of bird specifically adapted for living and gathering food along the edge of a body of water.

shoreline—the interface where land and water meet.

seine—a net that extends vertically in the water column and is drawn through the water by hand for the purpose of gathering small fish, shrimp, or other inhabitants of the water.

sign—the track, claw marks, chew marks or other evidence of an animal's presence excluding the feces.

simple leaf—a leaf composed of a single, undivided blade.

slip face—the sheltered face of a dune where sand falls without being packed. It is characterized by sliding or slipping spontaneously or as a result of only a slight disturbance.

social interaction—the nose-touching, recognition displays, combat or other exchanges between two members of the same species when they meet. The human hand shake is one example of social interaction in humans.

soil temperature—the temperature of the soil; the temperature of the soil at a stated depth below the surface.

solar energy—the energy that the earth receives from the sun in the form of heat, light and other radiation.

solvent—any material which will dissolve another material; the material in which another material is dissolved.

song (bird)—the melodious sound produced by many species of bird, primarily during breeding season and through which mate selection, breeding territory, defense and other breeding parameters may occur.

species—for the purposes this guide, all plants or animals that will freely breed with one another if brought together in a suitable habitat and which share common color, form and other characters. (Note: species is both the singular and the plural form of this word.)

spinal cord—the collected bundle or trunk of nerves which lies along the dorsal side [back] of many animals.

stabilized dune—a dune where plant cover prevents normal winds from transporting sand.

stem—the primary support organ of a plant on which leaves and flowers form and through which nutrients and water are transported up and food is transported to the roots for storage.

survival—the continuing to exist, either as a living individual or species.

taproot—a single main root that extends directly opposite from the stem and may reach many feet into the earth.

temperature—the measure of the amount of heat contained by any thing.

tracks—the impressions in sand or mud formed (1) by the feet of an animal or (2) by any part of a plant or animal that makes an impression in the surface.

transition—an orderly change over time from one state to another.

venom—a protein compound created by some animals which has a destructive effect on other animals when it is injected into them.

waterfowl—those species of birds primarily adapted to life on the water; ducks, geese, swans and their allies.

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Field Data Sheet for Collections

Date: _____ Time: _____

Location: (State): _____ County: _____

_____ miles from _____

_____

Air Temperature: _____ Water Temperature: _____ Soil Temperature: _____

Depth Temperature was measured; Water: _____ Soil Temperature: _____

Species Collected/Observed: _____

_____

_____

_____

_____

Wind Direction: _____ Wind Speed: _____ Water Salinity: _____

Sky: cloudy, partly cloudy, partly sunny, sunny, fog, haze, other _____

Precipitation: amount _____ kind _____

Specific Habitat: _____

_____

_____

_____

Remarks:

_____

_____

Directions: Reference location as distance and direction from nearest permanent landmark. Specific habitat is hole in tree trunk, crevice in a rock, etc. (microhabitat). Additional information that is not called for on this sheet (i.e. behavior or activity observed) may be of use to you and you should record all of your observations.