# BUILD A SANDY BEACH

#### Discipline

Biological Science

#### **Themes:**

Diversity, Systems and Interactions

#### **Key Concept**

Sandy beaches and the kelp which washes ashore are home to many kinds of organisms. (Diversity). Most of the animals living at the sandy beach are hidden from view under the sand to escape the pounding surf and hungry birds. (Systems and Interactions).

#### Synopsis

Students make bulletin boards and models of different views of the same sandy beach. They construct magnified models of organisms that live below the sand as well as the living and dead organisms that make up the beach wrack washed up by the waves. This activity could be completed in about three to four hours.

#### **Science Process Skills**

observing, communicating, comparing, organizing

# Socail Skills

sharing ideas and information, checking for agreement

# Vocabulary

beach wrack tide wave predator prey scavenger habitat adaptation burrow filter feed plankton antennae organism

#### MATERIALS

INTO the activities

• *MARE* Sandy Beach Slide Show or picture/video images of sandy beaches (the slide show is available for purchase from *MARE*)

- drawing paper and crayons or colored pencils/pens (for each pair)
- masking tape

THROUGH the activities

For the whole class • resource material such as pictures or books with colored pictures, photographs or blackline drawings of sandy beach creatures. The following are good sources and available for check-out from the MARE library: One Small Square Seashore, by Donald M. Silver Marine Biology Coloring Book, Thomas Niesen Beachcomber's Guide to the Gulf Coast Marine Life, Thomas Niesen Beachcomber's Guide to California Marine Life, Thomas Niesen The Seaside Naturalist, Deborah Coulombe The Audubon Society Field Guide to North American Seashore Creatures A Field Guide to Seashores Coloring Book *Exploring the Seashore*, National Geographic Society Eyewitness Books, Seashore and Shell Seashore Identifier, Bob Lollo What Lives in a Shell?, Kathleen Weidner Zoehfeld Look Closer Book, Shoreline, Barbara Taylor The Seashore Book, Charlotte Zolotow Where the Waves Break, Anita Malnig Seashore Surprises, Rose Wyler Shore Life, Rena Kirkpatrick Shells of the World, A.P.H. Oliver Seals, Sea Lions and Walruses, Dorothy Hinshaw Patent Elephant Seals, Sylvia Johnson Seals and Sea Lions, Blake Publishers A Beach for the Birds, Bruce McMillan A Coloring Book of Birds of California Shorebirds of North America, Alan Richards A Field Guide to Pacific Coast Fishes of North America, Eschmeyer, et.al. • crayons or colored pencils/fine point marking pens masking tape • half a bucket of rocks the size of walnuts (available from landscape supply stores)

• half a bucket of sand (available from pet, landscape, and building supply stores)

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• white glue

• 50 feet of brown or green butcher or construction paper to make stuffed organisms; or colored paint to paint white paper.

• 2 five-foot long pieces of sand-covered butcher paper (Paint butcher paper with watered down white glue and sprinkle all over with sand. It takes less than one half bucket of sand to cover two five-foot long pieces of butcher paper.)

- 5 feet of blue mural paper or blue cellophane
- one roll monofilament

• miscellaneous "junk" for students to design their own organisms including the following:

string, Styrofoam, crepe paper, marbles, toothpicks, pipe cleaners, black beads, feathers, various colors tempera paint, chopsticks, brush bristles, straws, colored markers, various colored tissue paper, plastic bags, curling ribbon, balloons

- lots of newspaper to use for stuffing organisms
- one box kleenex tissue
- key concepts written in large letters on strips of butcher or chart paper

For each student

• 1 piece of construction paper (used to back blackline illustration and make habitat drawings

- 1 11"X17" light colored construction or other paper for mini-books
- 1 blackline illustration (see illustrations attached)

For each group of 10-12 students (3 groups total)

- 1-3 staplers
- 5 or more scissors
- 2-3 small bottles of glue
- masking and clear tape
- modeling clay, various colors including purple, white, red, about 1 lb.
- 5-10 paper plates

• construction paper, 1 pad or 30 large sheets, various colors including green, bright green, brown, black, white, purple, etc.

For the Beach Wrack group (materials in addition to above)

• 50 feet of brown butcher paper or equivalent amount of large sheets of green and brown construction paper

- 4 large sheets (11X17 or larger) of bright green cellophane or construction paper
- 4 large, 36 gallon-size, black or green garbage bags

• 2 cardboard boxes about 1 foot square each to make rocks (other sizes will do)

- 5-10 large green balloons
- 2 rolls brown crepe paper

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#### INTRODUCTION

We all have our "mind's eye" view of what we expect to see on a sandy beach. More than almost any other habitat, beaches conjure up just about as many different images as there are cultures around the world. What do you think of when the word beach is mentioned? Waves crashing, surfers riding the curls, vast expanses of sand, noisy cobbles grinding against each other, sunbathing, wind blowing, piles of kelp washing ashore, palm trees and sea turtles, cars and clam diggers, jellyfish glistening on the sand, shells strewn about after a storm, children and birds chasing the waves and on and on.

We have many different images of beaches because there are many different kinds of beaches. Even the same beach may look entirely different from one season to the next or even day by day. There is one thing they all have in common however -- the water and sand are in constant motion. Is it any wonder that most images of sandy beaches are quite barren of plants and animals? How could they make a living here? What is there to eat? How could they survive the crashing waves and scouring sand?

The answer to the riddle of life <u>on</u> a sandy beach is that most of the life is actually hidden <u>in</u> the sand. How might our image of a sandy beach change if we could actually see the myriad animals in this hidden world? Organisms in such numbers and such diversity that only a few can be mentioned here - such as sand (mole) crabs, olive and moon snails, beach hoppers, isopods, bristle and blood worms, razor and Pismo clams, and along the Gulf Coast, the bean clam.

Another important component of many beaches is the offshore organisms that may get washed onto the beach by winter storms, high tides and large waves. Beach wrack is made up of kelp and anything else such as empty shells and evidence of people (plastic and glass) which is washed ashore and stranded by tides. If stranded high enough on the shore, it can support a whole assemblage of organisms - its own temporary ecosystem with the rotting kelp at the base of the food chain. Most of the animals of the beach wrack are hidden underneath the algae (giant, feather boa, and bullwhip kelp) to avoid the bird predators and the hot sun. Scientists have discovered much of the action inside this wrack by using a miniature camera like the ones surgeons use. Some of the organisms taking advantage of this transient resource include beach hoppers, pseudoscorpions, rove beetles, and kelp flies. Rocks with attached holdfasts containing barnacles, worms, and many, many other species ripped from the offshore kelp forests may also be present. A Gulf Coast beach wrack would have turtle, shoal, and widgeon grasses instead of kelp.

The vast expanse of beach and looming cliffs with which we are most familiar is host to another assemblage of organisms. Some of the organisms we associate with the beach such as marine mammals, use it as a site for escaping from predators, birthing and warming. Others, such as the birds, use it as a rich

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food resource. Some unlucky individuals such as jellyfish and sand dollars are found up on the beach as a result of waves pushing them ashore to their untimely death. Many organisms are ultimately washed up onto the beach after they die offshore. A variety of shorebirds including sanderlings, willets, turnstones, and snowy plovers can be seen feeding on organisms living just under the sand, while scavenging gulls are looking for whatever they can find. The lucky beachcomber may see sea stars on the beach, pelicans over the water and surfscoters diving in the waves offshore. Plankton, sand dollars, surfperch and halibut could be found in the nearshore water. Harbor and elephant seals may be seen hauled out on the beach along with jellyfish and empty shells washed ashore. Beach wrack and grunions may be seen at the high tide line, the latter in Southern California. On the Gulf Coast loggerhead turtles, horseshoe crabs, ghost crabs and laughing gulls reward visitors to the beach.

# INTO THE ACTIVITIES

# Partner Parade

See the Teaching Strategies section for how to teach this activity.

- What would you like to do on a field trip to the beach?
- What animals live on top of the sand?
- What animals live below the sand?
- If you were a sandy beach animal, which one would you like to be and why?
- Besides the animals, what else could we see at the sandy beach?

#### THROUGH THE ACTIVITIES

# **Classroom Field Trip**

1. Tell students that they will now have the chance to visit a beach without leaving the classroom! Show pictures or slides of sandy beaches with little or no narrative or video images of a sandy beach with the sound turned off. As they watch, they may talk with a partner about what they see as if they were really on a field trip to the sandy beach.

2. At the end of the images, have them talk to their partner about everything they can remember that they saw on their "field trip".

3. Hand out paper and markers, and now have student pairs draw and label a picture of their favorite sandy beach scene, including at least three different organisms. Have students try to focus on one small niche or area within the sandy beach - some beach wrack, a large rock, backwash from a wave, a

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shovelful of sand, a hole or a section of wet sand where the birds are feeding, etc., rather than trying to draw the whole habitat.

4. Tape all the pictures up around the room and do a "Gallery Walk" where the students walk around looking at the pictures and quietly discussing them as if they were in a museum.

5. Show the slide show or video again, this time present some additional content about the sandy beach habitat and the organisms living there. (See the descriptions of the individual organisms described at the end of this activity and on the blackline illustrations.)

# **Researching The Classroom Sandy Beach**

1. Tell the students that the class will be split into three groups, with each making a separate diorama/bulletin board of a different part of the same stretch of sandy beach. Each group will become the experts on the organisms living in their part of the beach.

2. Remind the students that much of the sandy beach is hidden from view under the sand. Most people are not familiar with the organisms that live under the sand. Also discuss size differences between sandy beach organisms, such as some plankton at 1/8th of an inch long as compared to harbor seals at 5 feet long. What does it mean to magnify or reduce something and how might this help them make their dioramas?

3. Describe each of the three views of the 3-d beach by using the INTRODUCTION information and the following:

# **"BEACH WRACK"**

This model is constructed at 20X actual size so the details of many of the animals can be seen more clearly. The classroom beach wrack can be shown as if someone just lifted up the bunch of kelp to look underneath or at night when most of the animals are actively searching for food. Also included here would be empty shells and the parts of a bird that would be visible from within the beach wrack: a giant leg and beak probing for a meal.

a. Cover the floor where the model will be with about one half bucketful of rocks or cobbles about the size of walnuts to represent the sand grains when magnified 20X.

b. The 3-d model can be placed on the floor just to the side of the "ABOVE THE SAND" bulletin board.

# **"UNDER THE SAND"**

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This diorama uses a cut-away view to reveal the very important hidden part of the sandy beach. It shows the myriad of organisms that live underneath the sand, just out of sight and how they react to the changing tides and crashing waves.

a. The model starts with a large sheet of butcher paper taped to table edges or to the backs of chairs. (A refrigerator or similar sized box could be used instead of the butcher paper.)

b. Paint the top of the butcher paper or box with watered down white glue and sprinkle with sand.

c. Place the animals hanging on monofilament (fishing line) at the right level down under the butcher paper or cardboard as if they were living in invisible sand.

d. Add some holes in the paper or box "the sand" to show where the organisms are hiding or living within the sand.

e. Students working on this view could make two different versions or poses of their organisms to show them at high and low tide or when hit by a crashing wave.

f. The diorama can be placed just to the side of or below the "ABOVE THE SAND" bulletin board.

# "ABOVE THE SAND"

The panoramic view of the beach gives the opportunity to put the other two views into perspective and add additional organisms.

a. The backdrop for this view is a bulletin board showing a vast expanse of sand, looming cliffs and the rising and falling ocean. Use a large bulletin board or wall (about five feet wide) and cover it with a large sheet of brown or white butcher paper which has been painted with watered down white glue and sprinkled with sand. "Rocks" and "cliffs" may be added along the side and bottom of the mural.

b. Add a large sheet of blue mural paper or blue cellophane to the upper left corner to represent the water covering the sand. Connect the "water" along the top and side of the bulletin board, leaving the bottom so it can be lifted up to see what lives in the sand just offshore.

c. Some of the animals shown in this view (e.g. the elephant seals and pelicans) will have to be reduced from actual size while some of the other organisms (e.g. plankton) will probably need to be magnified (show a hand lens above them to represent magnification).

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d. Have this group use string and labels connected to the other two versions to graphically represent where they were taken from.

4. Divide the class into three groups as follows: the "Beach Wrack," "Under the Sand," and "Above the Sand."

5. Place drawing paper, colored markers or crayons, scissors, glue and the materials to make the organisms in 3-d in the middle of each of the groups' tables. Show students where additional materials they can use are located. Distribute available resource books around the room and give students time to browse.

6. Give each group the collection of illustrations (attached at the end of this activity) for their diorama. Have the students choose one of the drawings to color and then make into 3-d. Tell the students that if they have a question, they must first ask the other members of their group before calling on the teacher.

**Sidebar:** If you have time and extra helpers in your classroom, highlight some of the information about each organism as given at the end of this activity. Otherwise, there is enough information given on each drawing for the students to make their organism on their own.

7. Tell the class that they have four tasks to complete and model each of the tasks for them. (The Tasks are described below).

# TASK ONE: Coloring the sandy beach organisms

1. The illustrations have simple sentences for the students to read and suggestions about how to construct the organisms using the craft materials. Have the students color their drawing following the directions given on the illustration (e.g. "I am red", "I live in the sand", "I eat plankton"). In this case, students would color their animal red, show it living in the sand and add plankton to the drawing for their animal to eat.

**Sidebar:** As the students are working on the first two tasks, the teacher can circulate around the room answering questions about the organisms and helping students design their organism in 3-d.

# TASK TWO: Drawing the habitat

1. Have the students cut out the drawing from Task One and paste it onto construction paper.

2. Now the students can draw in a habitat scene around their organism including physical aspects of the beach such as sand, waves, and cliffs. Have them also draw what it eats and who eats it. Have the students again browse through the resource materials if they don't know what to draw.

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3. Once the students have completed Task Two, they can go onto Task Three and make their organism in 3-d.

# TASK THREE: Building the 3-d sandy beach

1. Remind the students to look at the materials in the center of their tables and think about how they might use them to build their organism in 3-d. If you plan on having the dioramas made to scale, remind the students to make their organism the correct relative size for their diorama, e.g. lifesize, reduced 50%, or magnified 20X.

2. If the students have ideas on how they would like to make their organism, they should go ahead and experiment using any of the other materials available.

3. Have students make a few of their 3-d organism and then if there is time, have them design and make a different organism.

4. Model some of the following techniques for making 3-dimensional organisms. This will be especially helpful for those students having trouble coming up with a design on their own. Our experience has been that most students readily enjoy and are successful with this type of open-ended activity.
mold bodies with clay, use toothpicks for legs, and pipe cleaners and construction paper for pinchers. (pseudoscorpion)

• to make really large worms, roll paper into tubes and tape enough rolls together to make it very long; segments of the worm can be shown with string tied around the body at intervals; chopsticks can be used for the bristles and black construction paper for jaws. (giant bristle worms)

• snails can be made out of clay using a marble in the center for the mold.

• to make clams - trace the illustration onto a paper plate, color, cutout (take care not to cut through the hinge) and fold at the hinge. Stuff with tissue and tape shut after adding the siphon and foot as described below. Roll two narrow tubes of paper to form the incurrent and excurrent siphons. Add a long, pointed white foot made from two pieces of construction paper, glued at the edges and stuffed with tissue. Both the siphon and foot could also be made out of clay.

• an opaque projector can be used to enlarge the illustrations to the appropriate size and then trace the outline on butcher paper taped to the wall. Copy and stuff as described above.

• tiny organisms (such as much of the plankton), can be shown larger than life in the model by placing them under an illustration of a hand lens.

• you may need to help make the 20X lifesize Giant Kelp, Bullwhip Kelp and Feather Boa Kelp. (see the individual descriptions on the attached illustrations)

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5. Most of the organisms in each of the three groups can be made 3dimensional by using the following stuffed pillow technique:

- •Draw the organism freehand
- •cut out two copies
- •color the outside of each of the copies

•staple the edges together, leaving an opening just large enough to stuff with torn newspaper; for small animals, use glue around the edges and stuff with bits of tissue.

•staple the remaining opening closed

**Sidebar:** We recommend that the students design organisms from the craft materials or draw the organisms freehand instead of cutting out the pre-drawn illustrations and making pillows. With encouragement, even the "I can't" students will be able to create a 3-dimensional organism with both accurate and fantasy features.

# TASK FOUR: Class presentations and placing the organisms in the model

1. As students complete their 3-d creations, have them make presentations to the class about all they have discovered.

2. Now have them place their organisms in the correct place within their group's view of the sandy beach.

# Making a Key for the Dioramas

1. Have a student randomly choose one of the drawings from Task Two and hold it up in front of the class, covering the name of the animal.

2. Students can take turns answering questions about that organism such as "what is my name?", "what do I eat?", what adaptations do I have to live on sandy shores?", "in what ways am I connected to other sandy beach organisms", and "can you find me in the dioramas"?

3. As each organism is described by a student, tape the picture up around the appropriate diorama, or as a border for the "Above the Sand" bulletin board. These pictures can then serve as the KEY for the displays. Alternatively, students can write the name of their organism on a small piece of paper or 3 X 5 card and tape this name tag on the organism within their display.

Finally, hold up the Key Concepts on butcher paper for one or more students to read aloud. Post them near the murals and dioramas.

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#### Mini-book

See the Teaching Strategy section for how to teach this activity.

Students can title their books, "Living On Sandy Shores". Chapter titles can be as follows: Chapter 1 Who lives at the Sandy Shore?; Chapter 2 Adaptations to the Sandy Shore; and Chapter 3 Interactions on the Sandy Shore.

#### BEYOND THE ACTIVITIES

#### Sketch the habitat displays

Have the students sketch the habitat displays. Have them sit quietly in front of one of the displays and sketch the habitat scene including physical aspects (sand, ocean) and the organisms living there. Have students put numbers by each of the organisms on their drawing and then on a separate sheet, have them list the numbers and the name of the organism. This can serve as the KEY to the displays.

#### Interconnections

Have students use colored yarn to join organisms within and between models which are interconnected in some way. Different colors can be used to show different relationships such as red for predator-prey, green for herbivore-plant, orange for sharing a microhabitat and black for mates.

#### **Genre Transformation: 3-Dimensional Dioramas to Dramatic Presentation**

Transform the 3-dimensional dioramas and bulletin boards into dramatic presentations. Have the original groups, Under the Sand, Above the Sand, and the Beach Wrack develop a drama about their part of the beach. Have the students include each of the organisms from their diorama in the presentation, showing interactions between the organisms and/or the physical environment. Students might make signs to hang around their neck to tell who they are pretending to be or hold one of the 3-d creations. A narrator could describe what is being presented as the play unfolds or describe what will be shown in the upcoming act. Alternatively, a game of charades could be played as the students watching try to guess what the actors are portraying.

# **Field Trips**

• Visit the Wild California exhibit in the California Academy of Sciences in San Francisco. One of the displays there depicts a 50X magnified view of beach wrack.

• Visit a sandy beach and take a trowel or shovel to dig in the sand to investigate the animals living there. Be sure to return each of the organisms exactly where it was found. Make a Bingo game before you go using reduced versions of the illustrated organisms included in this activity. While at the beach have the kids check off the organisms they see.

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# The following animals have simple sentences for the students to read and suggestions about how to construct the organisms in 3-D.

# The Beach Wrack

# **BEACH HOPPERS**

Life-size it is about 1 inch long, enlarge it to about 20 inches long and make into a stuffed pillow.



I have a gray body and bright orange and pink antennae.

I live in burrows in the sand by the kelp wrack.

I have long back legs to help me jump high.

I eat kelp.

Birds and rove beetles eat me.

#### **PSEUDOSCORPIONS**

You might like to use clay, toothpicks, pipe cleaners and construction paper. Life-size it is about as big as the letter  $\mathbf{m}$ . Enlarge it to about three and one half inches long, or as long as the last sentence below.



I have a brown head and yellow body with brown rectangles. My legs are striped brown and yellow. I catch kelp flies to eat with my pinchers. I live in the kelp washed onto the beach. Birds and rove beetles eat me.

#### **ROVE BEETLES**

Life-size it is less than an inch long. Enlarge it to about one and one half feet long, and make into a stuffed pillow.



I am a super predator of the beach wrack. I am yellow brown like the sand. I have jaws like a knife to catch prey. I eat beach hoppers. Birds eat me.

#### **KELP FLIES**

Life-size it is about one half inch long. Enlarge it to about ten inches long and make into a stuffed pillow.



I have a hairy brown body with red legs. I live my whole life in the beach wrack. Rove beetles and pseudoscorpions eat my maggots. I eat the kelp on the beach.

#### **GIANT KELP**

The diorama will only show about a one-foot piece of the giant kelp because life-size kelp is so large.

stipe - brown paper rolled into tubes about 10 inches wide and taped together to a length of 20 feet.

air bladder - stuff a large garbage bag with crumpled newspapers and tape the corners to round it out. Tape this to a paper tube five inches across and six inches long and then attach the tube to the stipe with tape. Make three of these air bladders and attach one to the stipe every eight feet.

blade - a stuffed pillow 14 feet long and five feet wide at the widest point. Stuff it to a thickness of about two and one half inches. Make a total of three blades and tape each one to an air bladder.



I make the giant kelp forests of the sea. I am brown in color. I can grow up to two feet a day. Winter storm waves wash me onto the beach. High tides push me higher up on the shore. I am a habitat for many animals.

#### FEATHER BOA KELP

**stipe** - a stuffed pillow about 20 inches wide, 20 feet long and about three inches thick.

**blades** - a stuffed pillow about 40 inches long, 20 inches wide and one inch thick. Make many and tape along the sides of the stipe.

air bladders - inflated green colored balloons, taped to the sides of the stipe.



I am dark brown to olive green when alive.

A limpet which matches my color grazes on me.

I grow just offshore and also in the tide pools.

I have many blades and air bladders along the sides of my stipe.

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#### **BULLWHIP KELP**

**air bladder** -a large black plastic garbage bag made round by taping the corners and filling with crumpled newspapers.

**blades** - many 20 foot long crepe paper streamers taped to the top of the air bladder or make stuffed pillow blades about six inches wide and two inches thick.

**stipe** - roll paper into a funnel shape about 10 inches across at the widest point where it joins the air bladder. Roll another piece of paper onto the narrow end of the first funnel and repeat until the tube is about 20 feet long. The last funnels should be about five inches across.



I am shaped like a whip. I am olive green in color. Native Americans had many uses for me. Today, I am made into baskets and pickles. SEA LETTUCE



I am bright green. I look like a sheet of thin material with wavy edges. I am eaten by snails and people. I am especially good in soups and salads. **TURKISH TOWEL** 



I am dark purple in color. I have small bumps all over me. I look like a towel with rounded corners. I grow on the rocky seashore. Many small animals live under me. Many other algae grow on me.

#### THE HOLDFAST and ROCKS

Twist brown crepe paper into ropes for the holdfast. Make 10 ropes, each about two feet long. Glue one end of each rope to a rock (cardboard box) and gather and tie the other ends together to form the stipe.



I am home to many animals. I am light brown in color. I act as an anchor for the kelp. I am attached to rocks.

I am washed onto the beach by storms.

#### **BRISTLE WORMS**

Roll paper into a five inch wide tube and tape enough rolls together to make a six-foot-long worm. Don't forget really large bristles and black jaws.



I have sharp black jaws to catch other worms. I am a dark green color. Birds eat me. I can be found within holdfasts on the beach.

#### BARNACLES

Make a three foot high barnacle with a foot wide opening at the top.



I am white in color. I live attached to rocks. I am shaped like a volcano.

I eat plankton.

I capture plankton with my feathery legs.

# Above the Sand

SANDERLINGS

Make into a stuffed pillow.



I run along the beach and look like I am chasing the waves.

I eat beach hoppers and small sand crabs.

I use my bill to pick food off the surface and just under the sand.

I am seven inches tall with a one-inch long bill.

I am pale gray in color.

Peregrine falcons eat me.

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WILLETS
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Make into a stuffed pillow.



I am very noisy when I fly along the beach.

I have a black wing with a white stripe you can see when I fly. I am fifteen inches tall with a two and one half-inch long bill. I poke my bill into the sand to find worms, sand crabs and clams. I pick through the beach wrack to find beach hoppers and crabs. Peregrine falcons eat me.

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#### TURNSTONES

Make into a stuffed pillow.



I am about eight inches tall and have white patches on my wings. I use my bill to hunt under beach wrack for beach hoppers and insects. I also pick loose skin from elephant seals and poke my bill into the sand to look for the animals there. Peregrine falcons eat me.

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**GULLS** 

Make into a stuffed pillow.



I have a white body, a gray back and gray wings with black tips.

I am two feet tall and my open wings are almost five feet across.

I rest on the beach at high tide.

I look for food at low tide.

I am a scavenger and will eat almost anything.

Peregrine falcons try to eat me when I am small.

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Make into a stuffed pillow.



I am camouflaged to match the dry sand.

I have a black bill and black feet.

I am about seven inches tall.

I pick through the beach wrack looking for beach hoppers and rove beetles.

Peregrine falcons eat me.

#### PEREGRINE FALCON

Make into a stuffed pillow.



I have a black head, dark brown back and white chest with brown spots.

I am about one and one half feet tall.

I swoop down on my prey at almost 200 miles per hour.

I eat ducks, shorebirds and seabirds.

I build my nest on the cliffs.

#### HARBOR SEALS

Make into a stuffed pillow. These seals are about four feet long, so may have to be reduced to fit on the mural.



I am a marine mammal. I am silver gray with black spots. I eat fish and squid. White sharks and killer whales eat me. I spend about seven hours a day on the beach where I rest and get warm.

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#### **ELEPHANT SEALS**

Make into a stuffed pillow. These seals are up to 16 feet long and so will have to be reduced from actual size.



I am a marine mammal.

I am brown and have a huge nose and loud roar.

I am a great swimmer and dive very deeply.

I eat fish and squid and white sharks and killer whales eat me.

I can stay on the beach for three months at a time without eating.

# ARMORED SEA STAR

Make into a stuffed pillow or glue sand onto paper for the rough skin.



I live under the water and get washed onto the beach by storms.

I am pink in color and my arms have many spines.

I am about six inches across.

I eat snails and sand dollars whole and spit the shells out my mouth. I also eat dead animals.

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#### JELLYFISH

You might want to use inflated plastic bags or balloons and make tentacles out of ribbon or crepe paper. Some jellyfish are about one foot wide with five-foot long tentacles.



I am part of the plankton and I eat small fish. I get washed onto the beach by big storms. I can sting you even if I am on the beach. Sea turtles eat me. Some jellyfish are brown and other jellyfish have purple and white stripes.

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#### **BEACH WRACK**

You might want to make it out of dark brown or black construction or crepe paper and add shells, feathers and other things that would be washed ashore.



I am made of kelp and things like feathers and empty shells. I was washed ashore and got stranded by the high tide. Many animals make a home in me while I am on the beach. Birds search through my big pile for their hidden food. Beach hoppers and kelp flies eat my kelp.

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#### PELICANS OVER THE WATER

Make it into a stuffed pillow.



I am a big silvery brown bird with a white and yellow head.

I have a long yellow bill and a big black throat pouch.

When I get hungry, I fly over the ocean looking for fish.

I dive into the water to catch my dinner.

When I'm not looking for fish, I fly so close to the water that my wings almost touch it.

I am in most danger from marine pollution like pesticides, fishing line and hooks.

#### SURFSCOTERS

Make into a stuffed pillow.



If I am a boy, I am black with a white patch on my forehead and the back of my neck and a bright orange, black and white bill.

If I am a girl, I am dark brown with light brown patches on the sides of my head and a black bill.

I paddle on the surface of the ocean where the waves break.

I can dive down to 40 feet to find my food.

I swim under water with my wings.

I eat mussels, clams, snails, limpets, crabs and some fish.

Make into a stuffed pillow.



I have red-orange and blue stripes along my sides and bright blue streaks and spots on my head.

I live in the ocean where the surf breaks.

I am about 1 foot long.

I am caught by people fishing from the beach.

I eat all sorts of little animals like shrimp.

#### PLANKTON

You might want to show the plankton under a hand lens to show that it has been enlarged.



I can be almost invisible so that predators don't see me.

Some of us are tiny animals and some are plants.

I am not a strong swimmer.

I get pushed around by the currents and waves.

There are many animals at the seashore that eat me as they filter the water.

I am a very important part of the ocean food chain.

#### SAND DOLLARS

Make into a stuffed pillow.



I am light brown to dark purple.

I live under the water balancing on one edge of my shell. Big storms may wash me up onto the beach where I die.

I am white when I die.

I eat plankton and fish and armored sea stars eat me.

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#### Under the Sand

#### SAND (MOLE) CRABS

The illustration is life-size. Make it as a stuffed pillow. Add small black eyes on stalks and split feathers for antennae. Show it buried in the sand with its eyes and antennae sticking up above the sand or above the sand as if it were hit by a wave and about to dig in.







I burrow into the sand tail first. My antennae and eyes stick out of the sand. I stay where the waves break. I catch plankton on my hairy antenna. Birds eat me. I am blue gray or the color of sand.

# **BEACH HOPPERS**

Life size it is about 1 inch long. Make it into a stuffed pillow.



I have a gray body and bright orange and pink antennae. I live in burrows in the sand by the kelp wrack. I have long back legs to help me jump high. I eat kelp. Birds and rove beetles eat me.

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#### ISOPOD

The illustration is about 8x actual size. Make it as a stuffed pillow. Don't forget the small black eyes and skinny antennae.



I am a scavenger on dead animals. I am blue gray or sand colored. Birds eat me. I may nip your toes.

#### BLOODWORMS

Footprints and holes in the sand show where the birds have been feeding on these worms. You might use clay for the body and string for the gills.



I am colored bright red. I have red gills on the sides of my body. Birds and bristle worms eat me. Footprints and holes in the sand show where birds found me. I swallow sand to get the tiny bits of food as I burrow.

#### **BRISTLE WORMS**

You might want to use clay and add strong pointed jaws and many bristles. Show some of these worms eating the bloodworms.



I have sharp black jaws to catch worms. I have many bristles on my sides to help me burrow. I am a dark green color. Birds eat me. I burrow through the sand looking for food.

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#### **OLIVE SNAIL**

You might want to use clay (use a marble for a base) and don't forget to add the siphon and foot. Show the animal at low tide burrowing just under the sand (long slightly raised straight lines show where it is hidden). Also show it at high tide on the surface of the sand as it is searching for its prey.



I have a white and purple shell. I have a white siphon and foot. I use my foot to burrow at low tide just under the sand. I come to the surface at high tide to feed. I am a scavenger. Sea stars and moon snails eat me.

#### **MOON SNAILS**

Show the animal with about one third of its shell above the sand and its foot below, or show it completely in its shell with its trap door closed on the surface of the sand.



I am a snail with a light brown shell and beige foot. I drill holes in clams to eat them. I plow through the sand to look for clams. Only the top of my shell shows above the sand. Bat rays eat me. Native Americans used to eat me.

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#### **RAZOR CLAMS**

Use paper plates and construction paper or clay. Show these clams about one foot down as if they were trying to escape a clam digger. Or show the clam near the surface with its siphon extended to feed on the plankton.



I have a brown shell and white foot. My siphon has a brown tip. I filter plankton from the water for food. I burrow into the sand very quickly. People like to eat me.

#### **PISMO CLAMS**

Use paper plates and construction paper or clay. Show these clams with the siphon extended near the surface as they would feed at high tide, and also closed up tightly as if at low tide or when trying to escape a clam digger.



I have a light brown shell with purple bands. I eat plankton. I live in the sand near the surface. People and sea otters like to eat me.

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The following narrative provides additional information about some of the organisms on sandy shores you may wish to include in the classroom 3-D sandy beach.

## **Beach Wrack**

BEACH HOPPERS: **Orchestoidea** spp. These are small (about 1 inch long, not counting the antennae) shrimp-like animals with a body flattened side to side. They are crustaceans, related to lobsters and crabs. The body is basically grayish white, but the antennae are bright pinkish-orange. They are especially active at night and their primary food is the decaying seaweed they call home. During the day the hoppers are hidden away in burrows in the sand above the high tide line or underneath the wrack. On a visit to the beach, you can usually see birds busily poking their bills into the kelp in search of the beach hoppers. Other predators on the hoppers include pseudoscorpions which capture their prey with their venomous pinchers and rove beetles which capture them in their jaws and pierce their exoskeleton to suck out the fluids.

PSEUDOSCORPIONS: *Garypus californicus.* These voracious predators resemble scorpions, hence their name, and are related to spiders and other arachnids. These are tiny, about one eighth of an inch long (when enlarged 20X, they are about two and one half inches long). They have dark brown pinchers and head region, a yellowish body with brown-edged rectangles in each segment and striped brown and yellow legs. Pseudoscorpions live high up on the beach under debris, in rock crevices and also within the kelp wrack where they find their food. The pseudoscorpions grab just-hatched kelp flies with their pinchers before they can fly away and they also seem to relish beach hoppers. The poison in their pinchers first immobilizes their prey and then much like spiders, they inject digestive juices with their mouthparts and suck out the digested prey. They are in turn eaten by rove beetles and birds.

ROVE BEETLES: *Thinopinus pictus*. This super predator of the kelp wrack is only about three-quarters of an inch long and when magnified 20X about one and one half feet long. The rove beetle is yellowish brown, much like the sand. This insect will eat anything that stumbles close enough for it to grab. It lives in the sand and takes advantage of the kelp when it is there. It has large jaws which it uses like a knife to slice its prey. It mainly eats beach hoppers and kelp fly maggots and is eaten by birds pecking through the kelp.

KELP FLIES: *Fucellia* spp This annoying to humans fly, is about one half inch long and when magnified 20X is ten inches long. It has a hairy brown body with reddish legs. It completes its entire two week life cycle within the kelp wrack, so it is important that the kelp be high enough up on the shore so it doesn't get dragged out by the waves and tide. The maggots are found in the top 4 inches of the kelp and the adults are usually on top of the kelp, but may

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rest inside the wrack. Rove beetles and pseudoscorpions feed on the maggots and pseudoscorpions capture the young flies as they hatch out. Kelp flies eat the decaying kelp (they prefer giant kelp) and help break it down.

GIANT KELP: *Macrocystis pyrifera*. Giant kelp is khaki brown and dominates in the offshore kelp forests of Central and Southern California. It grows to 150 feet long with blades about eight to nine inches long, and three inches across, a one half inch wide stipe and air bladders about one inch across and two and one half inches long. Giant kelp is the fastest growing plant on earth, growing up to two feet per day. Winter storms break the kelp loose from the rocks to which it is attached and wash it ashore where it forms the large mats of wrack. It is eaten by beach hoppers and kelp flies and acts as home to many other species.

FEATHER BOA KELP: *Egregia* spp. This kelp grows from the mid-tide region out to the giant kelp forests. The stipe is a flattened strap about one inch across. The color is very dark brown to olive-green when alive or freshly washed ashore. There are lots of small blades coming off both sides of the stipe and numerous air bladders. The seaweed limpet lives and grazes on the stipe and is exactly the same color, affording it both food and protection through camouflage.

BULLWHIP KELP: *Nereocystis luetkeana*. This is the predominant species of kelp forests in northern California and further north. Bullwhip kelp grows to about 100 feet long, with a stipe ranging from about three eighths of an inch over most of its length to up to three inches near the huge single air bladder which may be seven inches across. Today people make pickles, dolls and baskets out of the bullwhip and Native Americans had many additional uses for it. The 3-d bullwhip kelp will have to be a very young specimen because it would be impractical to make a large, older individual.

SEA LETTUCE: **Ulva. spp** This bright green algae grows in thin (single cell thick) sheets up to three feet long and wide. It is eaten by periwinkle snails and people.

TURKISH TOWEL: *Gigartina corynbifera* Turkish towel is in the group of red algae, but is actually a dark purple color and has a texture much like a terry cloth towel.

THE HOLDFAST and ROCKS: The entwining finger-like mass of the holdfast anchors the plant to rocks. It can be very large, up to three feet high and wide. Holdfasts often drag the rocks on which they were attached to shore with them. Many species can be found in a holdfast thrown up on the beach including, kelp crabs, sea urchins, octopus, clams, snails and others and boring clams can often be found in the rocks.

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BRISTLE WORMS: *Nepthys californiensis*. These worms are sometimes found entwined within the holdfasts. It is a ferocious predator with hard, sharp jaws on the end of an extension of their throat (called a proboscis) which can shoot out from their mouth and grab their prey. The proboscis also helps them burrow through the sand. They are about 6 inches long and dark greenish-gray.

BARNACLES: These volcano-shaped arthropods usually grow on the rocks to which the holdfast is attached. The holdfast then starts to grow over the shell, often causing the death of the barnacle.

Other items you might want to add to your beach wrack: (remember to make these 20X actual size) empty shells bird leg, beak or feathers evidence of humans (plastic, glass and cans with goose barnacles)

A Gulf Coast beach wrack would have turtle, shoal, and widgeon grasses instead of kelp.

# **"UNDER THE SAND"**

SAND (MOLE) CRABS: *Emerita analoga*. These animals are found in dense aggregations, buried in the sand with only their beady eyes and "hairy" antennae showing. They are about two inches long and bluish-gray or sand colored. As the backwash from each crashing wave recedes over them, they use their antennae to catch the drifting plankton as it floats by. They must dig very quickly to keep from being washed away by the next wave or eaten by hungry shorebirds or fish.

BEACH HOPPERS: **Orchestoidea** spp. These are small (about 1 inch long, not counting the antennae) shrimp-like animals with a body flattened side to side. They are crustaceans, related to lobsters and crabs. The body is basically grayish white, but the antennae are bright pinkish-orange. They are especially active at night and their primary food is the decaying seaweed they call home. During the day the hoppers are hidden away in burrows in the sand above the high tide line or underneath the wrack. On a visit to the beach, you can usually see birds busily poking their bills into the kelp in search of the beach hoppers. Other predators on the hoppers include pseudoscorpions which capture their prey with their venomous pinchers and rove beetles which capture them in their jaws and pierce their exoskeleton to suck out the fluids.

ISOPOD: *Excirolana* sp. These animals are the counterpart of terrestrial carrion beetles. They are such excellent scavengers that they can reduce a fish to a skeleton in no time. They occur in great numbers whenever a large animal

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carcass washes ashore. This isopod is about one half inch long and grayishblue to sand colored. These scavengers are in turn eaten by birds.

BLOODWORMS: *Euzonus mucronata*. Dozens of bloodworms can be found in each shovelful of sand by digging from a few inches to a foot deep at about the mid-tide line. They are about two inches long and blood red with branched gills on both sides of nearly every segment of the worm. As the worm burrows through the sand it swallows many grains, much like an earthworm does. Anything edible is digested-everything else passes right on through.

BRISTLE WORMS: *Nepthys californiensis*. These worms are found 1 - 2 feet below the surface, often in the bloodworm zone where it is probably feeding on them. It is a ferocious predator with hard, sharp jaws on the end of an extension of their throat (called a proboscis) which can shoot out from their mouth and grab their prey. The proboscis also helps them burrow through the sand. They are about 6 inches long and dark greenish-gray.

OLIVE SNAIL: **Olivella biplicata**. These are one of the few snails that make their living in rather than on the sand. The olive snail is about an inch and one half long with a glossy, white and purple shell pointed at both ends so it can travel through the sand with less resistance. It has a large, wedge-shaped foot which it uses to plough through the sand and a long siphon which it can extend above the sand to bring water to its gills. It is eaten by sea stars, octopus, moon snails, crabs and fishes. The olive snail eats blades of drift kelp, and scavenges animals and small bits of food in the sand.

MOON SNAILS: **Polinices** spp. These are very large snails, up to 4 inches across. The shell is yellow to light brown with a beige to brown foot. They plow through the sand with their very large foot, with just the top one third of their shell showing above the sand. When their foot is fully expanded it is up to four times the size of the shell, but can actually be shrunk down enough to fit back into the shell completely with the trap door (operculum) closed tightly behind it. They prey on other mollusks, such as clams and snails by using their file-like tongue to drill a counter-sunk hole in the shell. They then insert their long snout into the hole and eat their prey.

RAZOR CLAMS: **Siliqua patula**. These clams can get up to six and a half inches long. They have a brown shell, a white foot and a brown-tipped siphon. They are very rapidly burrowing clams and can disappear from the surface between one wave and the next in about 7 - 10 seconds. They are able to burrow so fast because of their large, pointed foot which is up to 50% longer than their shell. They live on the lower part of the shore in shifting sand on surf-swept beaches. Like most other clams, they obtain food by using their siphon to suck in plankton-rich water which is then filtered and the plankton removed by the gills. People and starry flounders eat the razor clam.

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PISMO CLAMS: *Tivela stultorum*. (Along the Gulf Coast use the bean clam, *Donax gloudi*). The Pismo clam has a thick shell for protection against waves and predators because it cannot burrow as quickly as the razor clam. The light brown shell has purplish-brown bands and may be up to seven inches long, and four and one half inches wide. It lives in a permanent burrow oriented with the narrow, hinged side of the shell faced towards the ocean. They have short siphons and need to be near the surface so they can filter feed, in fact the tip of the shell can actually be seen just at the surface. These clams are now relatively rare because they have been overharvested by people. Sea otters also like to eat them.

# "ABOVE THE SAND"

All the birds described below are listed with common names only. For most birds, there is uniformity in how common names are used and it is not as important to also give the scientific name. There are many wonderful bird books, easily available, for students to find pictures of "their" organism.

# On the Beach

SANDERLINGS: These shorebirds feed in the backwash of waves on the surface and just under the sand probing for beach hoppers and small sand crabs. They can often be seen running along the beach in large flocks, seeming to chase the waves. They are seven inches tall and nearly white to pale gray with a one inch long bill. Peregrine falcons prey on them.

WILLETS: These noisy shorebirds probe into the sand with their two and one half inch long bill looking for worms, sand crabs and small clams. They also pick through the beach wrack looking for beach hoppers and crabs. They have a blackish wing with a broad white band which can be seen when they take flight. They are 14 - 17 inches tall. Peregrine falcons prey on them.

TURNSTONES: These birds flip over seaweed to eat the beach hoppers and insects hiding or living there. They are also seen picking loose skin off elephant seals and will probe in the sand for burrowing animals. They are eight inches tall with white wing patches. Peregrine falcons prey on them.

GULLS: There are many gulls seen on California beaches. One of the most common is the Herring Gull. They will eat almost anything, sea stars, crabs, dead animals, and even picnic lunches - they are real scavengers. Gulls fly over parking lots and drop hard-shelled animals like clams and sea urchins to break them open. They can often be seen resting in flocks on beaches at high tide and scavenging at low tide. They are 23 -26 inches tall, with a wing span of 57 inches. Peregrine falcons prey on young birds.

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SNOWY PLOVER: These very camouflaged birds are the color of dry beach sand, with black bill and feet. They are found feeding in the dry sand or beach wrack looking for beach hoppers, rove beetles, and will sometimes even eat young sand crabs. They are six to seven inches tall. Peregrine falcons prey on them.

PEREGRINE FALCON: These birds prey mainly on ducks, shorebirds and seabirds. They swoop down on their prey at 180-200 miles per hour. They are 16 - 20 inches long from their beak to the feet, with a black head, dark brown back and white chest with brown spots. They nest on cliffs. These falcons were nearly made extinct by the use of DDT.

HARBOR SEALS: **Phoca vitulina** This marine mammal is very shy, and will only come ashore where no people are around. It spends up to seven hours a day up on the beach, getting warm and escaping predators such as white sharks and killer whales. Their hind legs don't turn forward and their front flippers are very short so they can't climb on rocks easily. They are excellent swimmers and go back into the sea to find fish and squid to eat. They are silver gray with black spots and about four feet long and 250 pounds.

ELEPHANT SEALS: *Mirounga angustirostris* These huge marine mammals can be up to 16 feet long and weigh 5000 pounds if they are males. Females are about half as long. They are brown and the males have a huge nose and loud bellow. Seals hind legs don't turn forward and their front flippers are very short so they can't climb on rocks easily. During breeding and molting, elephant seals may spend up to three months at a time up on the beach without eating or drinking. They are excellent swimmers and dive deeply to find fish and squid to eat. Young seals are especially vulnerable to attacks by white sharks and killer whales.

ARMORED SEA STAR: **Astropecten armatus** These sea stars can move above or below the sand offshore. They are sand colored or pink, about six inches across and have five arms with many spines along the edges. This sea star doesn't stick out its stomach to feed like many other sea stars, but instead eats its food whole -one snail or sand dollar everyday. Empty shells are spit out through the mouth. It will also scavenge dead fish and other animals.

JELLYFISH : These animals, actually part of the plankton, are at the mercy of wind, waves and currents and may be blown onshore during storms. Although dead or dying once onshore, their stinging tentacles may still inflict painful stings. One common species is *Chrysoara* which is brown and about one foot across the bell, with five-foot long tentacles. Another species found on west coast beaches is *Pelagia* which has a bell two feet across with purple and white stripes and 10 foot long tentacles.

## At the High Tide Line

BEACH WRACK: Beach wrack is made up of kelp and anything else (such as empty shells, feathers, dead animals) which is washed ashore and stranded by tides and storms. If stranded high enough on the shore, it can support a whole assemblage of organisms - its own temporary ecosystem with the rotting kelp at the base of the food chain.

#### **Nearshore Water**

PELICANS OVER THE WATER: These huge birds have a wingspan of six and one half to seven and one half feet and are 45 - 54 inches tall from the tip of their beak to the tip of their tail. These birds fly above the water looking for fish, then make quick downward plunges extending the neck and holding the wings far back as they hit the water. When not feeding, they fly just above the water, almost touching it with the tips of their wings. Their main predators are marine pollution including discarded fishing line and hooks and DDT.

SURFSCOTERS DIVING IN THE WAVES OFFSHORE: These are powerful diving birds, plunging to 40 feet or more for food. They eat mussels, soft-shelled clams, snails, limpets, crabs, and some fish. They are 17 - 21 inches long from their beak to their tail. Gulls eat the very young surfscoters.

SURFPERCH: These fish are found only in the north Pacific and the 18 different species are usually brightly colored. Many occur off sandy beaches in the surf. They are often caught by fishermen from the beach and some species are fished commercially. The young of these fish are born alive; no eggs are laid. The striped surfperch is very colorful with reddish orange and blue stripes along the body, and brilliant blue streaks and spots on the head and gill cover. The upper lip is black. The fish reaches a length of 15 inches.

PLANKTON: Microscopic plankton are animals and plants at the base of the food chain. Zooplankton may be the young of many species such as crabs, sea stars, and beach hoppers which will one day live on the sandy beach. Zooplankton may also be made up of the young of animals which spend their whole life swimming in the sea, such as fish and krill. Phytoplankton are plants which supply over half of the worlds oxygen. Many animals of the seashore eat plankton by filtering the water.

SAND DOLLARS: **Dendraster excentricus** These animals live just offshore upright in the sand with one edge buried and the rest of the animal exposed. They are about three inches in diameter and light brown to dark purple when alive, but bleach to white when they die and are washed ashore. These relatives of sea stars eat zooplankton and bits of algae and are eaten by some fish and armored sea stars.

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# Other animals you might like to use

grunions by-the-wind sailors halibut egg collars from moon snails mermaids purses (shark and ray egg cases)

On the Gulf Coast use loggerhead turtles, horseshoe crabs, ghost crabs, and laughing gulls.

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