

# Unit One

## Introduction to Marine Invertebrates

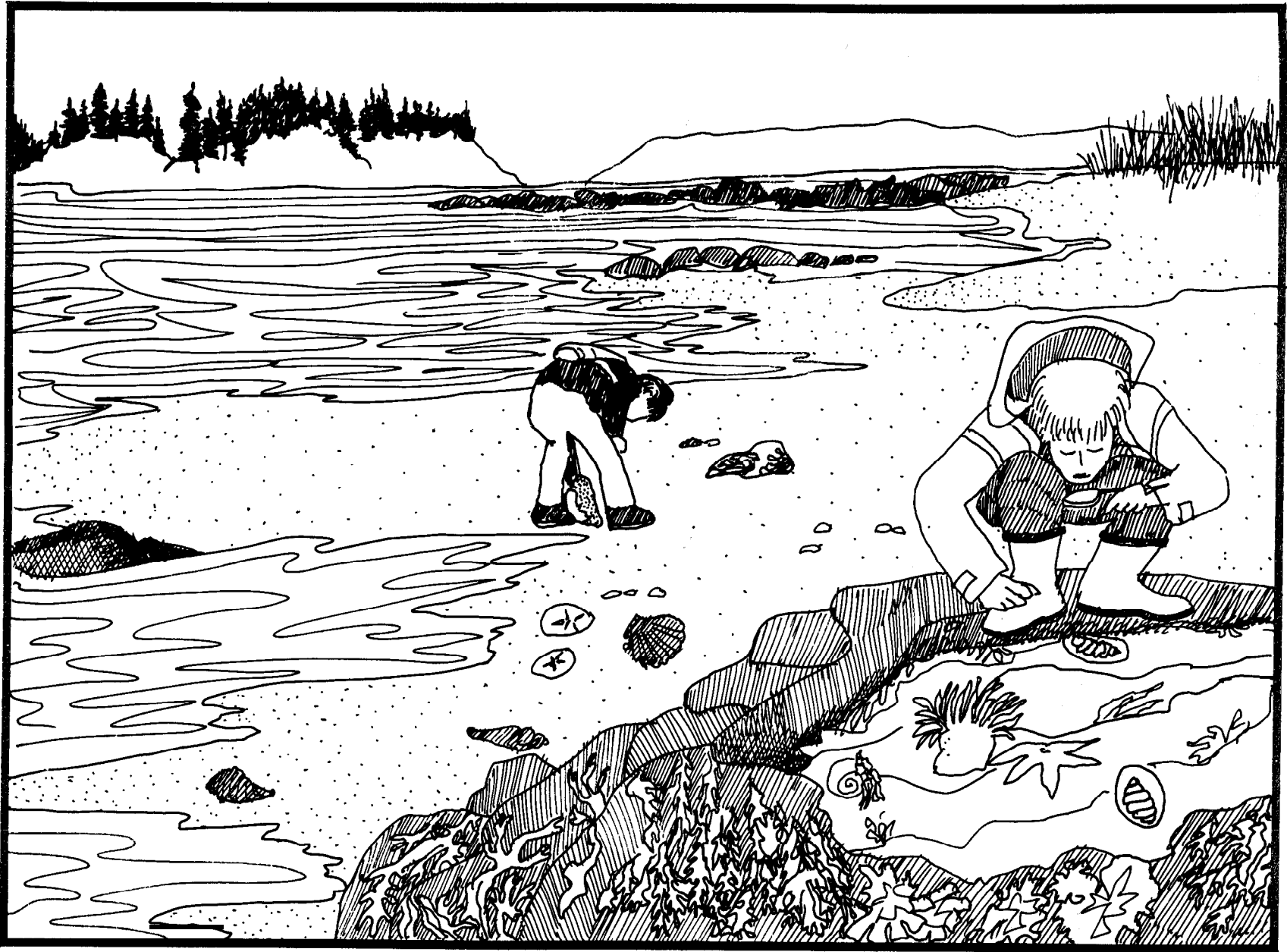
Activity 1 - Live Sea Animals ...3

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### Objectives:

To help students:

- Touch and identify common beach creatures such as sponges, jellyfishes, anemones, worms, crabs, barnacles, shrimps, amphipods, mollusks, sea stars, sea urchins and sea cucumbers (Activity 1).
- Understand the meaning of “invertebrate”: a soft-bodied animal without bones (Activity 1).
- Talk to a diver and/or marine biologist and observe their equipment (Activity 2).
- Decorate the classroom like an undersea world (Activity 2).
- Train “animals” (paper bag puppets) for an underwater circus (Activity 2).



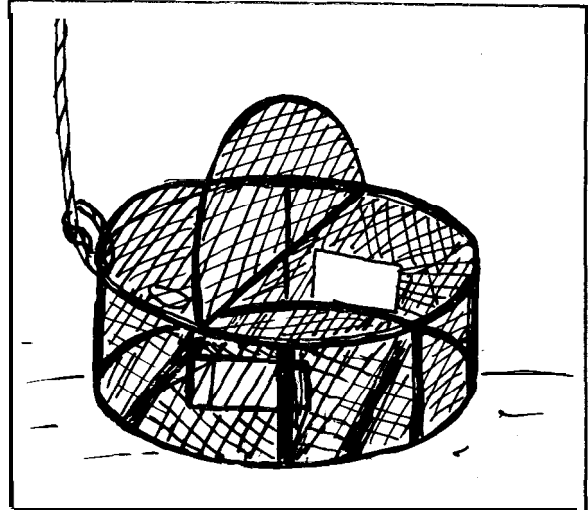
UNIT ONE: Introduction to Marine Invertebrates. The ideal way to approach the study of invertebrates in all their diversity is through observation of live animals.

All living things can be classified as belonging to either the plant kingdom or the animal kingdom. Vertebrates and invertebrates are the two major subdivisions of the animal kingdom. Vertebrates are animals with backbones: humans, horses, elephants, mice, fishes, etc. Invertebrates are animals without backbones: sponges, sea stars, insects, worms, jellyfishes. Ninety-five percent of all animal species are invertebrates.

There is a great assortment of colors, shapes and sizes among invertebrates found in Alaskan waters. Lacking backbones, they have various ways of supporting their bodies. Some, such as anemones, rely on the water itself to give them shape and support. Sponges have a support system of needlelike structures, which form an entwining mesh. Crabs, shrimps, and beach hoppers have external skeletons, or "exoskeletons," that must be shed as they grow. The skeletons of sea stars are composed of small plates; the plates of sea urchins and sand dollars are fused together to form a test. The soft bodies of snails and clams are encased in protective shells that increase in size as the animals grow.

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## Activity 1 Live Sea Animals



### Background:

In teaching children about marine biology, nothing compares in excitement and value to the observation of living creatures. On the coast, live sea animals can be collected from the shore at low tide (rocky beaches have the most diversity), under floating docks or pier pilings, or from divers or fishermen. A crab pot, old tire or rope, set offshore or hung from a dock, will often attract creatures. An animal skull works extremely well for bait. Use the information in Unit 2 to help with identification of your finds.

Inland schools can obtain live animals from friends on the coast or parents visiting the ocean, or can order them sent air freight from biological supply companies.

Plan to return the creatures alive to their homes on the shore after this activity. That way, there will always be animals for future Sea Weeks!

## Vocabulary:

- . invertebrate
- . exoskeleton
- . sponge
- . jellyfish
- anemone
- . worm
- . crab
- . barnacle
- . shrimp
- . amphipod
- . mollusk
- . univalve
- . bivalve
- . snail
- . sea slug
- . nudibranch
- . clam
- . mussel
- . sea star
- . octopus
- . chiton
- . sea urchin
- . sand dollar
- . sea cucumber
- . sea squirt
- . habitat

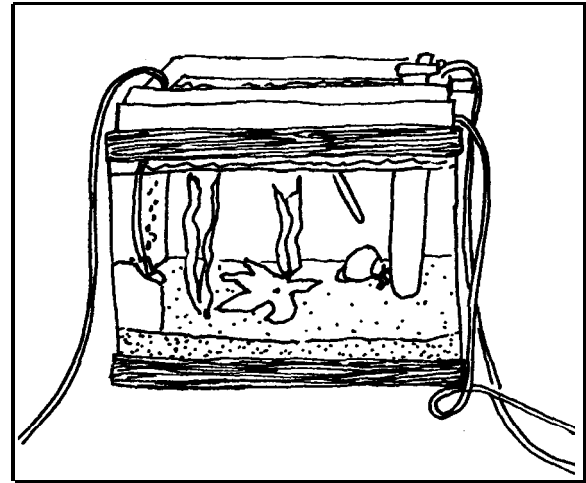
## Materials:

- live sea creatures
- magnifying lenses or binocular microscopes with lights
- finger bowls

## Procedure:

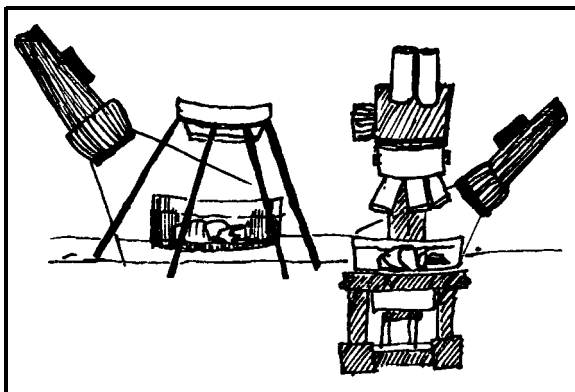
1. Obtain the sea animals. Remember conservation! It is important that live animals be treated well and returned to their proper habitats. salt-water aquariums are ideal (use natural salt, sea water or marine salt, available at pet shops); but if none is available, animals can be kept for several days covered with paper towels dampened with salt water, in wet seaweed, or in a pan of salt water in the refrigerator.

The most important rule is to keep the water cool at all times, which is necessary to maintain a sufficient oxygen level. As soon as the water begins to lose its chill, return the pan to the refrigerator. Don't use a metal pan, which can corrode and poison the animals. Most intertidal animals are hardy, but if one of yours becomes sluggish, return it to the sea. It is best not to collect sponges, which decay quickly.



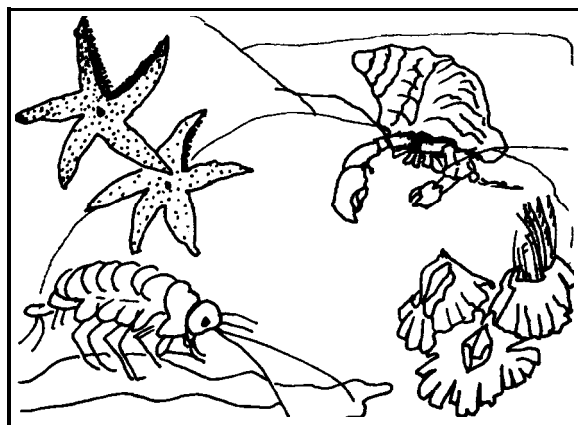
2. Build excitement about Sea Week by encouraging students to inspect and touch the animals. It is safe to gently handle them. Jellyfishes may be touched on the bell but should not be picked up, as their tentacles, located on the underside, may sting.
3. Write student questions about these animals on the board as starting points for future studies.
4. Introduce the word "invertebrate" as meaning "soft-bodied animal with no bones." Have the children find and feel their own backbones.

5. Discuss the habits of invertebrates. Where are invertebrates found? What are their needs? How can we help take care of them? (by being careful of them when we go to the beach, by not stepping on them, by filling in any clam holes we dig, by turning rocks back over after we look under them).
6. Set up the magnifying lenses or binocular microscopes. Explain the purpose of the instruments and how to operate them. Place an animal in the finger bowl in salt water, turn on the light and focus. Use flashlights with the magnifying lenses. The beauty and strangeness under magnification are impressive. (Remember, however, that the light produces heat that can warm the water and the animals, so turn the light off when you're not using it.)



7. Have students watch the way a jellyfish moves in an aquarium or plastic bag of salt water. Let students touch the tentacles of an anemone and feel their stickiness (due to the discharge of stinging cells, or nematocysts). Count the legs of crabs and shrimps and feel their hard shells.

Under duress, a hermit crab will sometimes jump out of its shell. If this happens, put it quickly back in its saltwater home so that its soft abdomen will be protected. Notice how the fleshy abdomen is adapted at its tip to hang on to a shell, and observe the loss of appendages on the abdomen. Then place the empty shell next to the hermit crab, and watch how it examines the shell and inserts its abdomen.



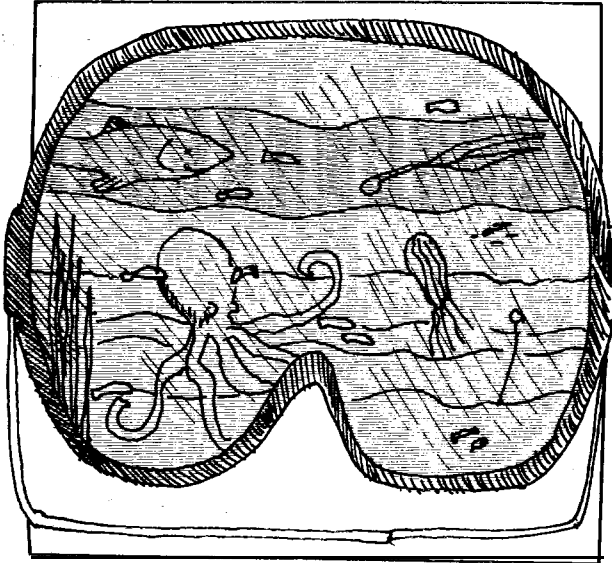
Watch barnacles feeding with their feet. How does an amphipod move? Is the clam's shell open just a crack to let it feed? Can you tell where a snail or limpet has been? (They will leave trails on the rocks sometimes.) Watch the tube feet of a sea star waving about. Place the sea cucumber in a pan of salt water when observing it and be careful to disturb the cucumber as little as possible because, as a protective measure, it may extrude its internal organs. The sea cucumber will grow its insides back, but that takes time and energy.

8. Conclude the session by having students tell what their favorite animals are, and why.

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## Activity 2

### Making an Undersea World



#### Background:

Children invariably are fascinated by the undersea world. By decorating your classroom, students will have a chance to use their imaginations and artistic skills, while learning more about the sea and its inhabitants.

#### Materials:

- masking tape
- plastic sponge
- coarse sandpaper
- crayons
- paper
- clothes iron
- red finger paint
- black marker
- newsprint
- dried sea star
- sand
- glue
- construction paper
- scissors
- yarn or string
- paper bags
- paintbrush
- powdered tempera paint

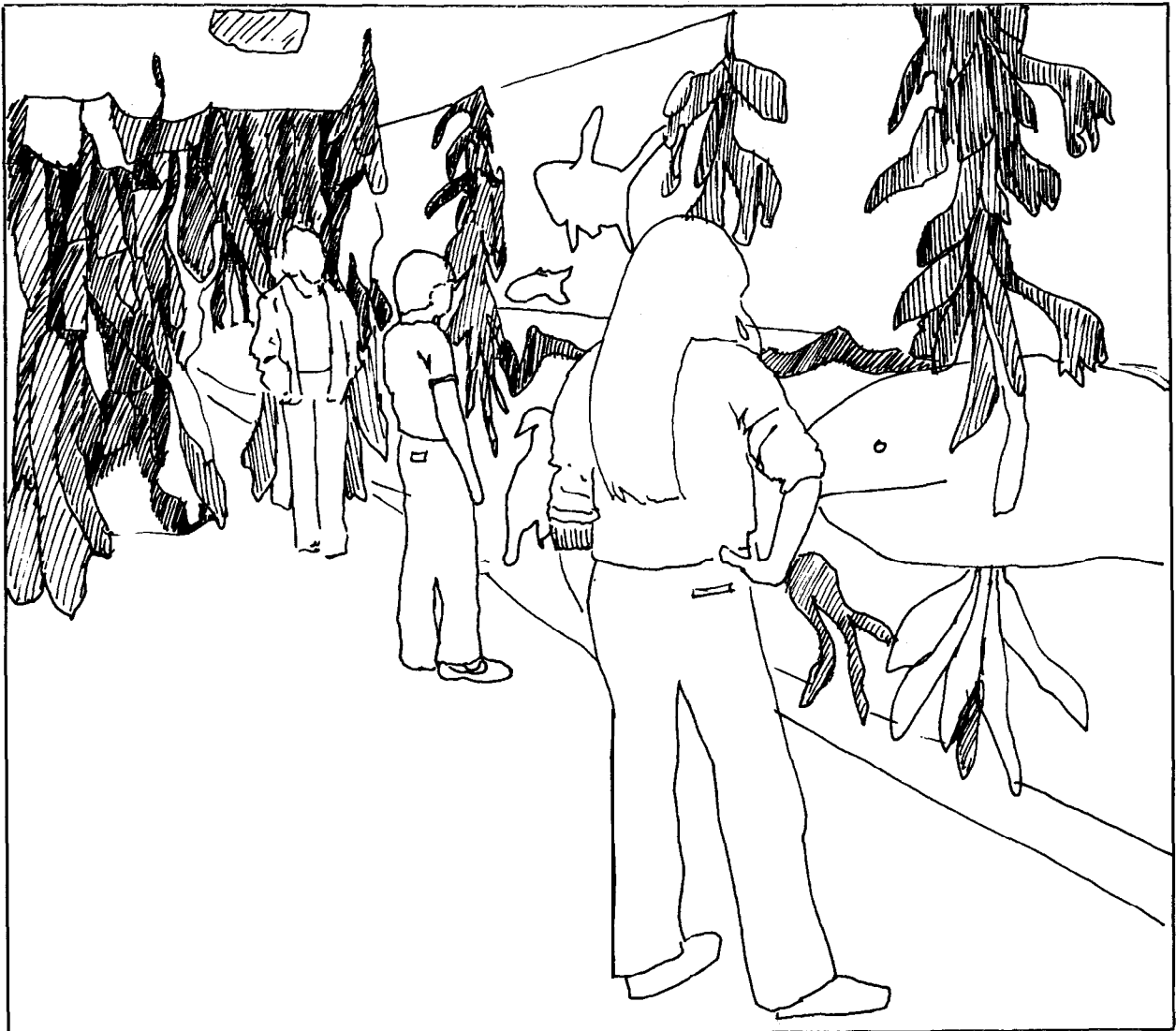
#### Procedure:

1. Invite a diver or marine biologist to demonstrate his or her equipment and show underwater slides.
2. Ask the students about their own ocean adventures. Have them make construction paper cutouts of the animals and label with names based on their own: Susannah Sea Squirt, Joe Jellyfish, Annie Anemone, Kathy Clam. Attach yarn or string, and hang the cutouts decoratively. The nicknames can be used later on field trip name tags.
3. Select a variety of art activities that will turn your classroom and hallways into an undersea world: hang colored tissue paper beneath fluorescent lights to act as a filter; hang art projects and seaweed streamers from the ceiling; make murals; ask students to bring sea treasures from home such as nets, floats, shells and driftwood. Additionally, you can:
  - a. Make paper waves from construction paper and tape to window shades. Tape sea birds, boats and planes above the waves, and sea animals below them. When the shades are drawn, it's low tide! (Suggested by the teachers at Badger Road Elementary, Fairbanks.)

- b. Have the class cut jellyfish shapes from coarse sandpaper. Color the sandpaper heavily. Place a sheet of white paper over each sandpaper jellyfish and iron over it to make a jellyfish impression.
- c. Cover a piece of paper with red finger paint. When the paint has dried, draw and cut out the outline of a sea star.

Using a sponge and orange tempera paint, give the sea star a mottled look.

- d. Brush tempera on a dried sea star. Sometimes one can be found freshly dead at the beach (but don't kill any just for an art project!) Cover it with a sheet of newsprint. Holding the paper in place, gently rub over the sea star to transfer its image.



Sea Week at Denali Elementary School in Fairbanks.

- e. Make sea paintings, using powdered tempera paint, sand and diluted glue. Clean the sand and mix with paint powder (not too much). Keep the colored sand in baby-food jars. Spread glue on paper with a paintbrush and sprinkle sand over the wet glue. Students can make original designs or use ones that have been mimeographed. Frame and hang these. (Suggested by Kathy Amerman, Maureen Coon, Kathy Dill and Larry Trani, Baranof Elementary, Sitka.)
  - f. Make a "sea letter mural." Attach a long piece of paper to the wall. Have students use a black marker or crayon to outline a sea plant or animal; then color the drawings and label with the first letter of their creatures' names. When finished, students should notify the teacher so that the animals' full names can be added.
  - g. Make crabs out of construction paper circles folded in half. (Suggested by Joanne Rogers, Paul Banks Elementary, Homer.)
4. As a finale, have an underwater circus. Ask students to each pick an animal to train and show off. Make sea animal hand puppets out of paper bags, with features cut out of construction paper and glued on. Have students plan appropriate puppet acts. Practice and then do a program for parents and other classes. (Suggested by Joanne Rogers, Paul Banks Elementary, Homer.)



# Unit Two

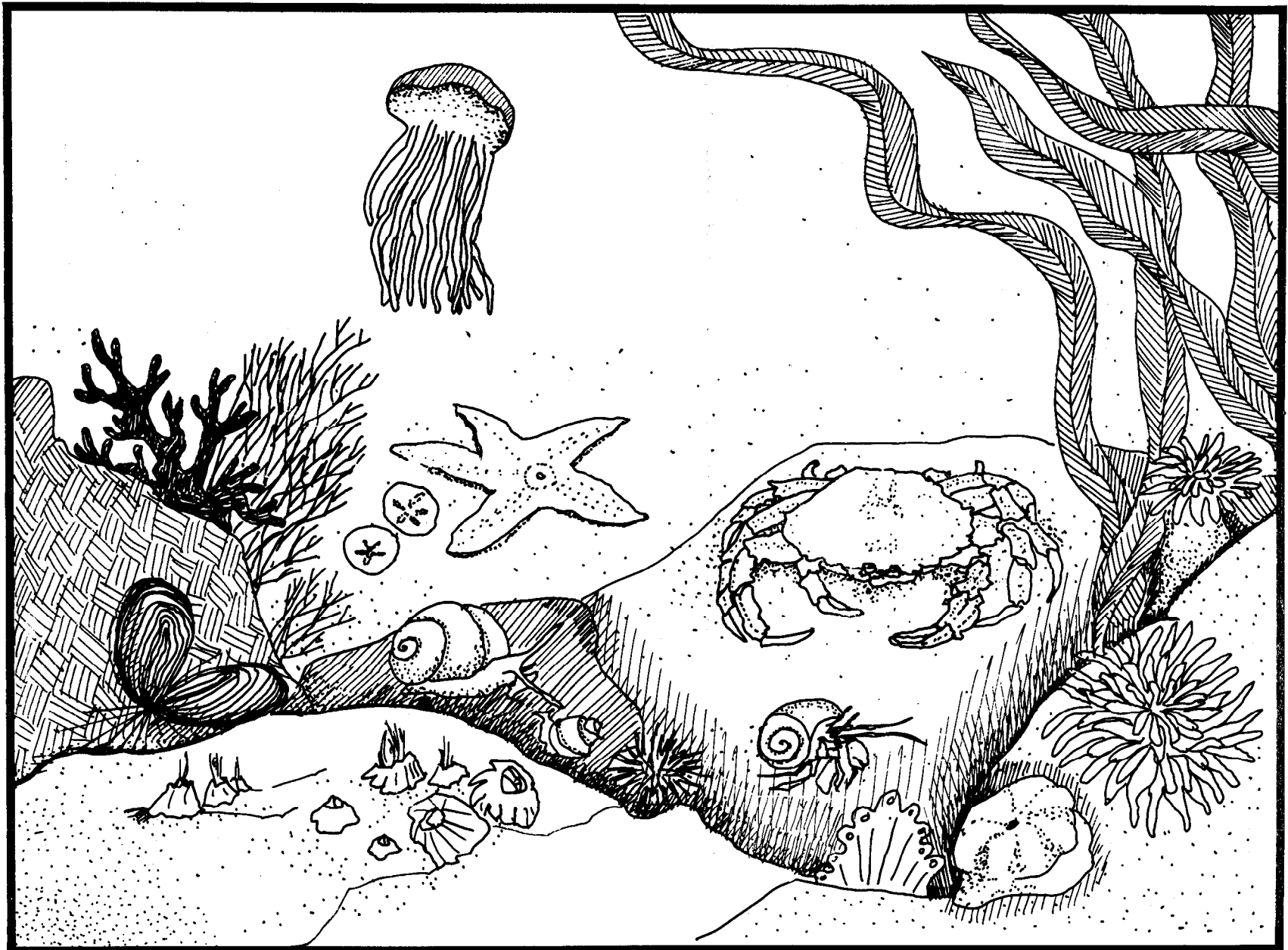
## Marine Invertebrate Species

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### Objectives:

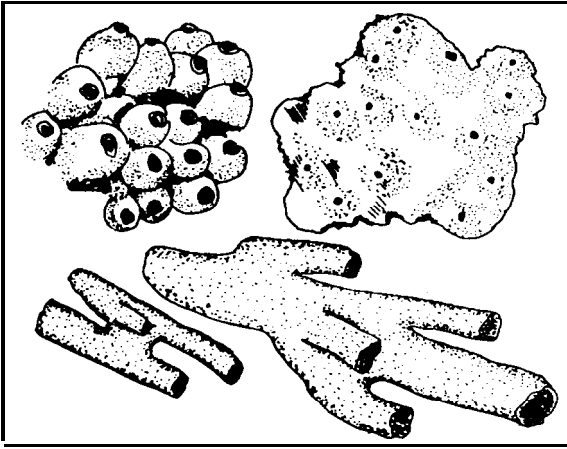
To help students:

- Practice reading, writing, coloring and numbering skills with marine invertebrate worksheets (Activities 1-8).
- Compare natural and synthetic sponges (Activity 1).
- Make sponge prints (Activity 1).
- Design, make, and wear jellyfish or anemone costumes for a class play (Activity 2).
- Write a class poem or story about worms (Activity 3).
- Sing a song with hand motions about crabs, shrimps, barnacles and amphipods (Activity 4).
- Listen to Pagoo, a story about a hermit crab (Activity 5).
- Investigate and taste crab (Activity 6).
- Construct a mollusk puzzle using two-dimensional shapes (Activity 7).
- Make three-dimensional sea stars, brittle stars, sea cucumbers, sea urchins and sand dollars out of clay or dough (Activity 8).
- Compare sea squirts to marine invertebrates (Activity 9).



UNIT TWO: Marine Invertebrate Species. Bottom ridge, left to right: barnacles, closed sea anemone, open sea anemones. Middle ridge, left to right: mussels, snails, sea urchin, hermit crab, Dungeness crab. Background: sand dollars, sea star, jellyfish.

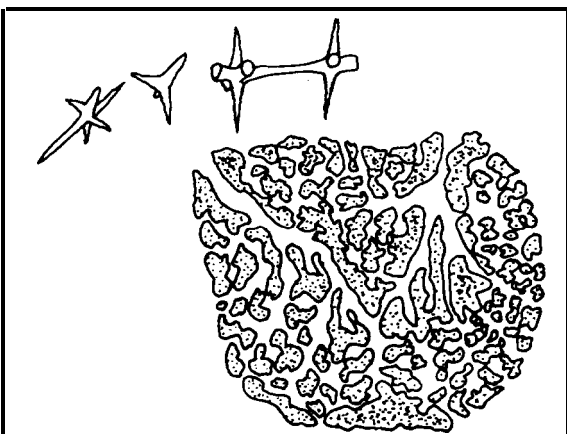
## Activity 1 Sponges



### Background:

In Alaskan waters, sponges are primarily subtidal, but some may be found in the intertidal zone. Intertidal sponges usually are inconspicuous, encrusting species growing under ledges, in crevasses, on rocks and boulders. Shades of green, yellow, orange and purple predominate, but other colorations may be found.

Sponges have been largely unchanged for 500 million years. Because they taste bad, they have few natural enemies. Some sponges shelter other organisms in their internal cavities.



If an intertidal sponge is examined with a magnifying glass, its scattered incurrent and excurrent openings can be seen. Flagellated cells draw sea water into the sponge mass through small incurrent openings. The sea water passes along internal passages and exits the sponge through the larger excurrent openings, which resemble volcanic craters. Inside the sponge mass, the flagellated cells along the passages capture microscopic bits of food from the passing water.

Sponges are given shape and texture by fibers and tiny, often elaborate siliceous or calcareous structures called "spicules." Biologists use the size and shape of these spicules to identify sponge species.

Some sponges have a distinctive form, which may resemble vases, fingers or balls; but others are amorphous. Sponges produce larvae that drift for a time in the water, then settle to the bottom and stay in the same place to grow and mature. They have no head, eyes, legs or heart.

### Materials:

- Natural sponge (old-fashioned bathtub type)
- Synthetic sponge pieces (one per student)
- Tempera paint
- Paper cut in sea animal shapes
- Construction paper
- Scissors
- Glue
- Worksheets
  - ... Sea and Wetland Activity Book (cover)
  - ... Guess What I Am? (2-A)
  - ... The Cut and Paste SpongeStory(2-B)

**Procedure:**

1. Have students compare a real sponge with the synthetic type. What differences can they see, smell, feel? Explain that real sponges are live animals gathered by undersea divers. Synthetic sponges are put together in a factory. Show the class the properties of sponges that make them valuable to people and useful to other sea creatures. They soak up liquids! Their central cavities provide places for smaller animals to hide or feed. And sponges taste terrible--so few animals eat them.
2. Have the class make sponge prints. Dip pieces of synthetic sponge into tempera paint, then press them lightly on paper cut in sea animal shapes. Glue the animal shapes to a construction paper background.
3. Talk about sponge colors and shapes. Show the class pictures of sponges from magazines or books. Have them complete the sponge

worksheets. (The Cut and Paste Sponge Story was designed by Chris Normandin, Nikolaevsk Elementary, Nikolaevsk. )

**Additional activities:**

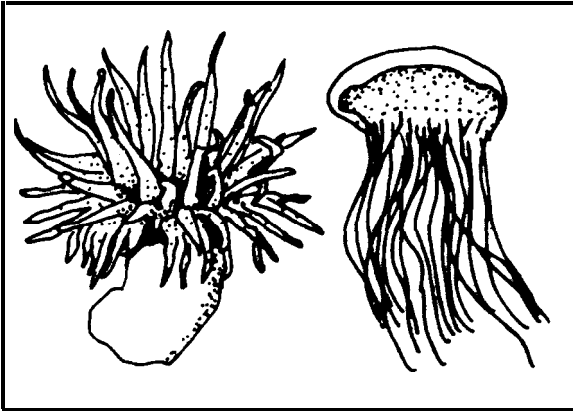
1. Art, Science : Have students cut out construction paper sponges of different shapes and colors, then draw pores, attachments and other details. Use for a corner room display.
2. Science. Show students sponge skeletons! Add a few drops of laundry bleach to a small piece of real sponge. Swirl or stir with a glass rod until the sponge material starts to visibly disintegrate.

With an eye-dropper, carefully draw up some of the liquid, put a drop of it on a slide and add a cover slip. Place the slide under the microscope and see how many types of spicules you can find. Different species of sponges depend for structural support on different types and combinations of spicules .

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## Activity 2

### Jellyfishes and Anemones



Jellyfishes and anemones belong to the same phylum, "Cnidaria," also known as "Coelenterata." In some species, the life cycle of the animal actually includes an alternation of generations: the jellyfishes reproduce sexually, producing larvae that settle to the sea floor and become anemone-like animals. These in turn reproduce, asexually, to produce jellyfishes.

Drifting and weakly swimming through the water, the soft-bodied jellyfish is shaped like an umbrella or bell. Its mouth is in the center of its undersurface, and its tentacles dangle like a fringe from the edge of the bell. In its tentacles are cells called "nematocysts" that rapidly emit tiny poisonous and sticky threads after contact by prey organisms. The animal is stunned, and the tentacles then entwine and convey it to the jellyfish's mouth. The nematocysts of some species, such as the large lion's mane jellyfish, can sting painfully; children should be cautioned not to touch any jellyfish they find either stranded on shore or drifting in the water.

An anemone is somewhat like a jellyfish turned upside down. The main part of the animal is an upright column. At the top of the column are its tentacles, and in the center of the ring of tentacles is the animal's mouth. Like jellyfishes, most anemones have nematocysts in their tentacles that they use to stun and capture prey. Students may touch the anemone's tentacles with their fingers without fear of being hurt. Do not touch the sensitive skin of the face, arms, legs, body or tongue to the anemone, however.

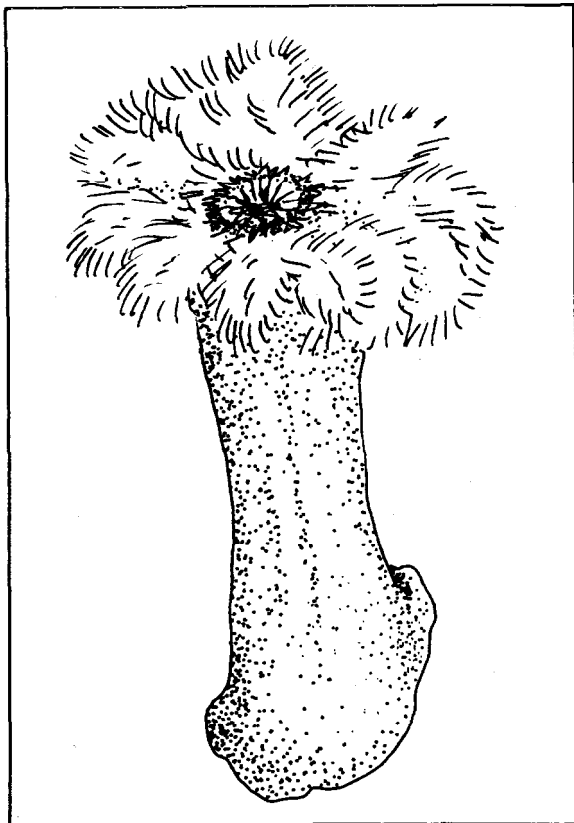
Anemones, like jellyfishes, have no bones and need water both inside and out for support. Out of water, they look like masses of gelatin. If children find such a specimen ashore, urge them to look into the water nearby. There they are likely to spot an anemone upright, expanded and beautiful.

Most anemones attach themselves to hard surfaces and move so slowly along the sea floor that their movement goes unnoticed. Some, however, look, live and behave in unusual ways:

1. Some subtidal anemones construct and live in tubes that extend downward into the substrate. These creatures protrude from their tubes to feed, but may withdraw into them if threatened.
2. Some other, uncommon types of anemones are relatively mobile and can flop slowly over and over as if doing cartwheels.
3. Responding to the presence of predatory sea stars, members of at least two species actual-

ly let go of the bottom and swim feebly, with writhing motions.

Anemones reproduce in several ways. Like almost all animals, they can reproduce sexually. Eggs and sperm are released through the anemones' mouths. Fertilized eggs grow into tiny larvae that drift for a time, then settle to the sea floor to grow into adults. In one species, the fertilized eggs develop within the female and move out through the mouth to attach as small individuals at the anemone's base; when they are large enough they move away to the surrounding rocky area. An anemone may also reproduce by splitting in two, dividing itself top to bottom through the center of its column and oral disc.



Several species of anemones may be found intertidally in Alaska. These are three of the most conspicuous :

1. Anthopleura artemesia is small, about two inches in diameter, and is found in a range of colors, including pink, copper and green, always with bands of lighter and darker shades of the main color along the tentacles. The green color of Anthopleura is caused by symbiotic (mutualistic) algae. Anthopleura can often be observed in tidepools with its tentacles fully extended. This anemone may anchor itself to a rock covered with sand or mud; when the tide is low, it appears as a small, raised, sandy ring that retracts when touched.
2. Tealia crassicornis is sometimes called the "Christmas tree anemone." It has a pattern of irregular streaking of red, green and tan. A large anemone, it is often left exposed at low tide on Alaska shores.
3. Metridium senile is usually white and differs from the other two species in that its tentacles are finer and appear almost feather-like. Sometimes called the "cauliflower" or "plumose" anemone, this species is often spectacularly abundant on pilings and under docks. It feeds mostly on zooplankton--the characteristically tiny animals that float in great numbers in the ocean.

#### Vocabulary:

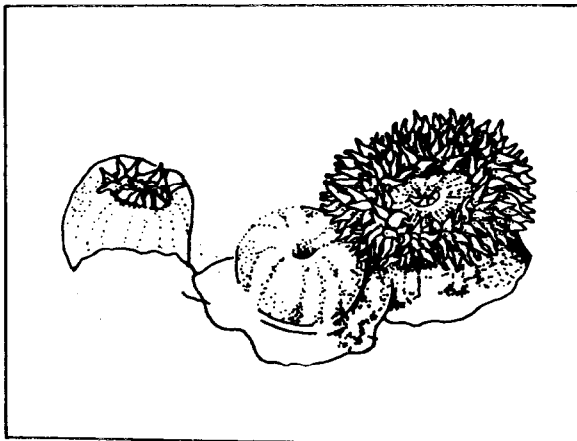
. tentacle

## Materials:

- pictures of anemones and jellyfishes in books and magazines
- long, narrow balloons
- paper streamers
- old sheets or bedspreads
- scissors
- tape
- stapler
- worksheets
  - ... Sea Anemones (2-C)
  - ... Anemone Poem (2-D)
  - ... Sea Anemone Sentences (2-E)
  - ... Dot-to-Dot Mvsterv (2-F)
  - ... Jellyfish (2-G)

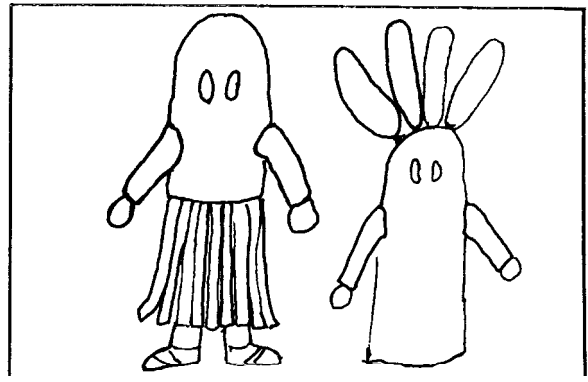
## Procedure:

1. Show the class pictures of jellyfishes and anemones from books and magazines (or from the worksheets). Talk about how the animals live. Explain that anemones at low tide pull in their tentacles to keep from drying out.



Jellyfishes are often stranded on the shore, and depend on the tide to wash them back to the water. Once they land on the beach, many dry out in the sun and die.

2. Have students complete the sea anemone and jellyfish worksheets. (Sea Anemone Sentences was designed by Joanne Rogers, Paul Banks Elementary, Homer.)
3. Have students make up a class play about anemones and jellyfishes--how they eat and survive. Make costumes out of old sheets or bedspreads, paper streamers and balloons. Use scissors, tape, and staplers to put everything together. Children might want to save their costumes for Halloween.



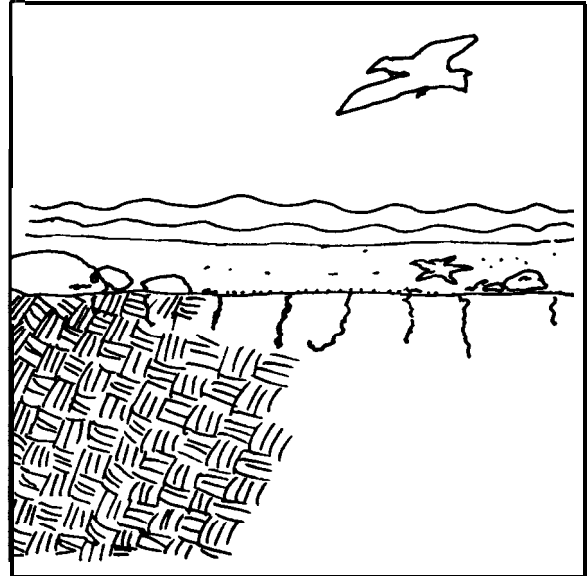
## Additional activities:

1. Art, Science : Make jellyfishes and anemones from construction paper. Curl strips of paper for tentacles.
2. Science : Jellyfishes and anemones are difficult to keep alive in the classroom--so try to limit your observations to beach trips. If you do have live jellyfishes or anemones, ask students to watch their behavior. Place the jellyfishes in a plastic bag of salt water so that students can see their undulating movements and their tentacles. Caution students not to touch stranded jellyfish at the beach; they might get stung!

Students can touch the tentacles of anemones, and can try to feed them bits of food (pieces of fish, meat, shellfish). What happens? Have students watch anemones in and out of the salt water. Notice how they attach themselves firmly to a surface. Try not to disturb them. Scientists think anemones may live 100 years or more, as long as food is available, so don't let them die by human hand. Keep them cool, and return them to the ocean as soon as possible.

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### Activity 3 Worms



Worms of many kinds are an inconspicuous but important part of any beach. Many species have adapted to their habitats in specialized ways. There are species of worms living naked in sand or mud substrates, some that live commensally with larger animals, and others that reside in parchment-like or calcareous tubes.

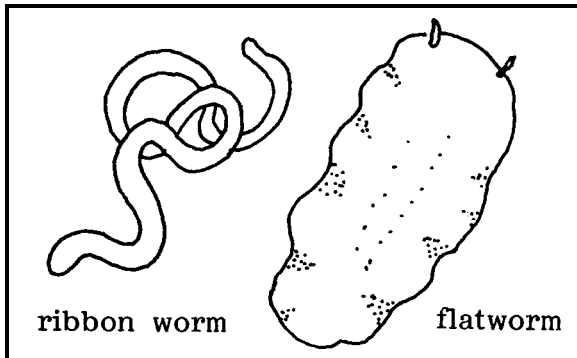
Worms serve a vital function in their environment by loosening the substrate and processing nutritive material into the food chain. They are themselves on the menu of birds, fishes, and other animals.

Although the term "worm" as it is commonly used refers to slender, wiggly animals with no legs, there are actually a vast number of worm species--some slender, some fat, some with appendages and some without. Five main groups, or phyla, of worms may be found on Alaskan beaches :

1. Platyhelminthes (flatworms)  
These may be as long as four



inches, but most measure only a fraction of an inch. They are flat and seem to flow over a surface, often looking like a moving spot on a rock or shell. They may be found on moist surfaces and are interesting to watch through a magnifying glass.



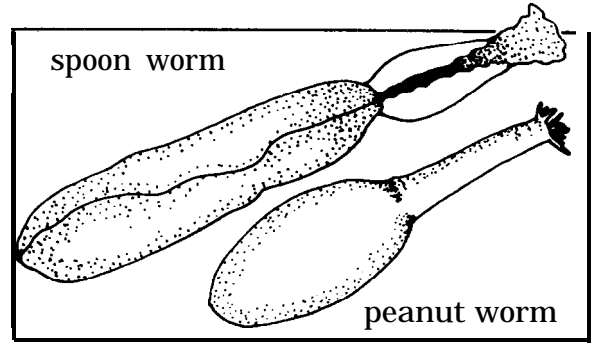
2. Nemertea (ribbon or proboscis worms)

Ribbon worms are round, sometimes highly colored, and quite elastic. A specimen that is a foot long when contracted may be capable of stretching to 10 feet. Ribbon worms break apart easily, and each severed part is capable of producing a new individual. They feed by everting a mouth apparatus called the "proboscis."

Some ribbon worms burrow into the sand or mud, while others live among clusters of barnacles, mussel shells or other marine organisms.

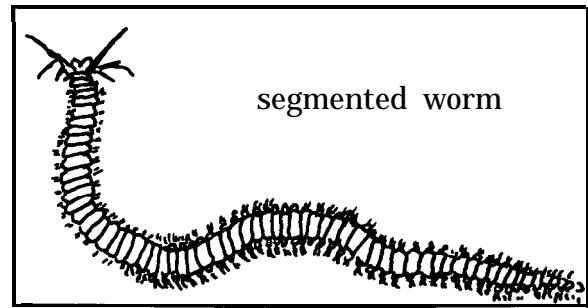
3. Echiura (spoon worms)

These take their common name from the shape of the proboscis, which when contracted looks like a spoon. They live in burrows and may be found under intertidal rocks in muddy areas with their proboscis projecting from the burrow. They are two to three inches long.



4. Sipuncula (peanut worm)

Taking their common name from their bulbous shape, peanut worms are burrowers in sand or mud and are often found in low intertidal areas. They may be several inches long.



5. Annelida (segmented worms)

The annelids are a large group of worms (including the common earthworm) with segmented bodies. The motile surface dwellers have well-developed heads with sensory organs including eyes, taste buds and tentacles. Others have reduced sensory structures on the head and may have tentacles or other structures used for feeding on the organic material associated with sediment. Many annelids have appendages called parapodia that are used for crawling, digging or swimming.

Annelids are greatly varied in size and appearance. The backs of some are covered

with scales (scale worms) ; some live in calcareous or parchment-like tubes (tube worms) ; and others live in cones made of cemented sand grains. Annelids can be found in virtually every type of marine habitat (as well as in fresh water and on land). Some form part of the zooplankton) some burrow in mud, others live under rocks or shells, and there are even some living in sediments of the deep sea.

### Vocabulary:

- . flatworm
- . ribbon worm
- . spoon worm
- . peanut worm
- . segmented worm

### Materials:

- pictures of worms from books or magazines
- chalkboard or butcher paper
- chalk or magic markers
- worksheets
  - ... Worms (2-H)
  - ... Worm by Letter (2-I)
  - ... Tube Worms (2-J)

### Procedure:

1. Show students pictures of worms from books and magazines, or from the worksheets. Discuss the way that worms eat and are eaten, and the role they play in loosening beach sands and muds.

Distribute the worksheets -Worms, Worm by Letter, and Tube Worms.

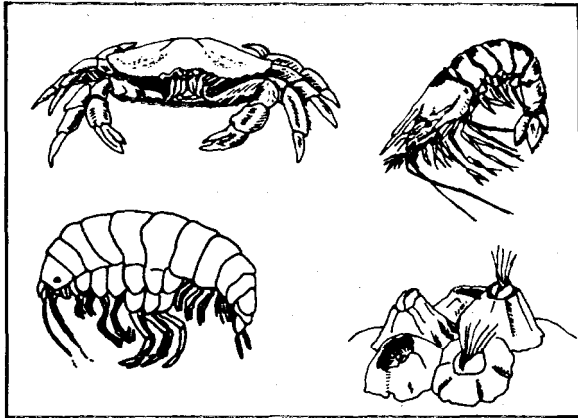
### Additional activities:

1. Art, Math: Have students cut worm shapes out of construction paper. Write math problems on one side of the cutouts and the answers on the other side.
2. Science: To help students get over any squeamishness about worms, bring some live ones into the classroom in a container of sand or mud. Ask students some of the following questions :
  - How long is the worm?
  - What color is it?
  - Does its body have segments (rings)?
  - How fancy or plain is its head? (Use a magnifying glass. Worms that crawl over the surface and hunt actively usually have well-developed sensory apparatus on their heads, Look at the tentacles on the heads of the tube worms.)
  - How many legs does it have?
  - Does it move fast or slow?
  - Will it stay in your hand when you hold it?
  - How quickly can the worm bury itself?

Return the worms to the beach when you are finished watching them.

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Activity 4  
The Crustaceans:  
Crabs, Shrimps, Barnacles  
and Amphipods



**Background:**

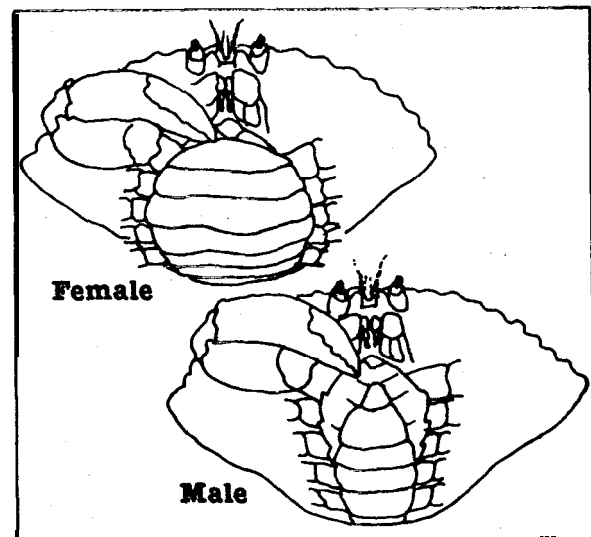
Crabs, shrimps, barnacles and amphipods belong to the class Crustacea, a large group related to insects. Like ants and beetles, crustaceans have a hard external skeleton and jointed legs.

Numerous kinds of CRABS may be found in Alaska. Small shore crabs are sometimes abundant in tidepools or other moist, protected places. Small, spiny juvenile king crabs can sometimes be found stranded by a receding tide. Hermit crabs--unique animals that protect their soft abdomens by living in empty snail shells--may be numerous on rocky shores, typically in tidepools.

Crabs are non-swimming, bottom-dwelling animals usually protected by a hard outer covering, or "exoskeleton." Although each of the many Alaskan crab species has its own distinguishing features, all crabs share certain characteristics:

Growth: When we grow, our bones lengthen and get

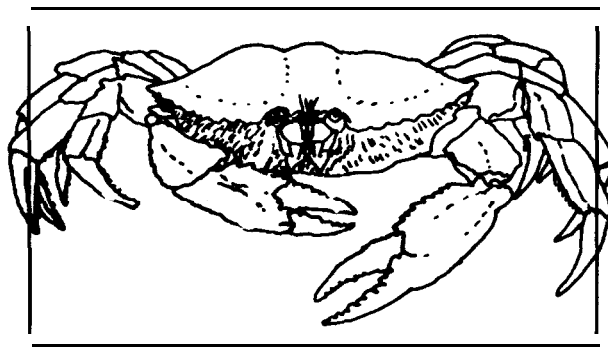
larger, and the soft muscle and other tissue making up our bodies grows too. Crabs grow in a different way. Instead of an internal skeleton, they have a hard outer shell that cannot expand. In order for a crab to grow, that shell must be shed, or "molted." In this molting process, a new, larger soft shell forms between the animal's muscles and the older hard-shell covering. This is visible as a red or brown covering over crab meat. When the old shell has been shed, the new one expands and hardens to protect the soft animal inside.



On the beach, students may find empty crab shells. If a shell is whole, it will have a narrow opening on its rear edge--the exit used by the crab when it backed out of its outgrown shell.

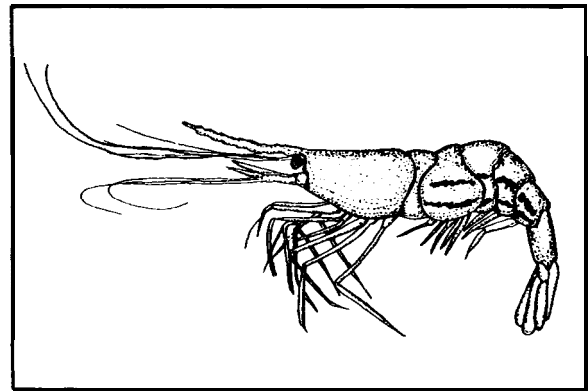
Movement: A crab's legs are jointed on different planes to allow complex maneuvering that probably helps it to escape a predator or capture prey. It can move sideways just as easily as it moves forward or backward.

Feeding: Most crabs feed on whatever they can find, including annelid worms, clams, snails, and sea stars, alive or freshly dead. (Crab fishermen report that crabs won't eat rotten bait.) Crabs are equipped with large claws specially adapted for digging in the sediment, tearing and pulling apart food, as well as for catching it. The claws also carry food to the crab's complex mouth.



Reproduction: Among crabs, the sexes are separate. The male crab typically attends the female as her molting time approaches, and mating usually occurs after molting. (Among tanner and other spider crabs, the females no longer molt after reaching maturity, but do continue mating.) The female then extrudes the eggs, which she carries attached to her abdomen until they hatch. The tiny swimming larvae are part of the ocean's plankton until they molt several times, change form, and settle to the sea floor to become adults.

The female crab's abdominal flap is broader and larger than that of the male, because it covers and protects the eggs she carries for much of the year.



SHRIMPS are not common intertidally in Alaska, but children occasionally may find some in tide-pools; these are usually small and not likely to be of a commercially important species. Unlike crabs, which are compressed top to bottom, shrimps are flattened side to side. Five species of shrimps are fished commercially in Alaska: pink, humpy, sidestripe, coon-stripe and spot shrimp. Of these, the spot shrimp are the largest, sometimes weighing as much as a quarter pound.

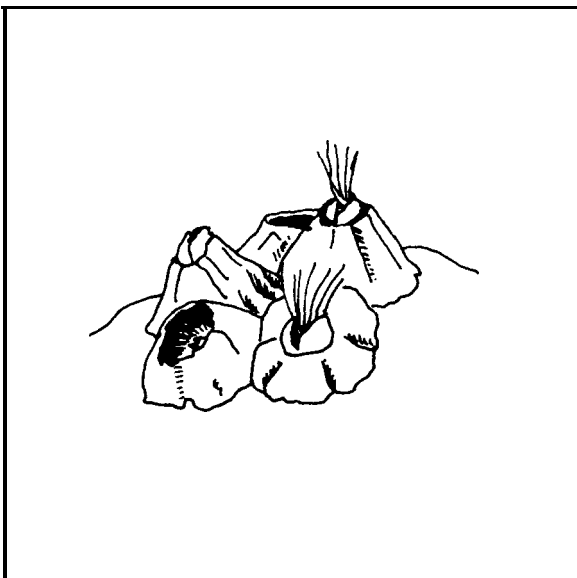
Shrimps are crustaceans, capable of swimming and walking. Their ten forward legs are used for traversing the ocean floor, and their abdominal appendages (called swimmerets) are used for swimming. Some species generally stay on the bottom during the day and swim upward in the water column to feed at night.

Like other crustaceans, shrimps must molt to grow. Like her crab cousins, the female shrimp carries her eggs among her abdominal appendages until they hatch. Some species of shrimps in Alaska have a curious life cycle in which all members of the species begin life as males, but are transformed after several years into females, remaining as such for the rest of their lives.

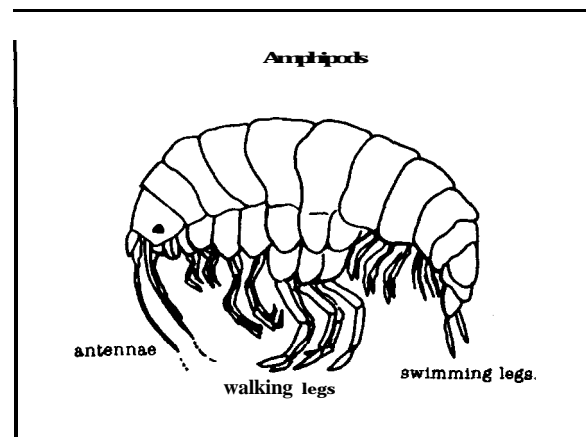
**BARNACLES**, very common on Alaska's shores, are encased in a hard, calcareous covering made of several overlapping plates. They use modified appendages to sweep the water. Acorn barnacles collect food particles, and gooseneck barnacles prey on tiny animals.

The young barnacle is free-swimming like other crustacean larvae. When it settles to the ocean floor, however, the barnacle attaches itself by its head to the substrate and starts to secrete a hard, calcareous sheath around itself. When the protective cover is complete, it usually is conical or columnar, and is topped by plates that open like a double-sliding door. Through the opening, the barnacle inside sticks out specially modified legs that wave rhythmically through the water to collect bits of food.

Different varieties of shore-dwelling barnacles live in different beach zones, and several species thrive on rocky Alaskan beaches. Drifting, open-water gooseneck barnacles may be washed ashore on outer coasts.



**AMPHIPODS**, also called beach or sand hoppers, are small, active, laterally compressed animals almost completely covered by an external skeleton. They have strong back muscles that they can flex in order to leap or hop. These animals are usually scavengers; they can be found under rocks and in nooks and crannies formed by the growth of other organisms. Amphipods are the street cleaners and garbage collectors of the marine environment. When food such as crab pot bait or a dead fish on the ocean floor is available, they may congregate in great numbers. In spite of their small size, they can quickly strip a food source to the bones.



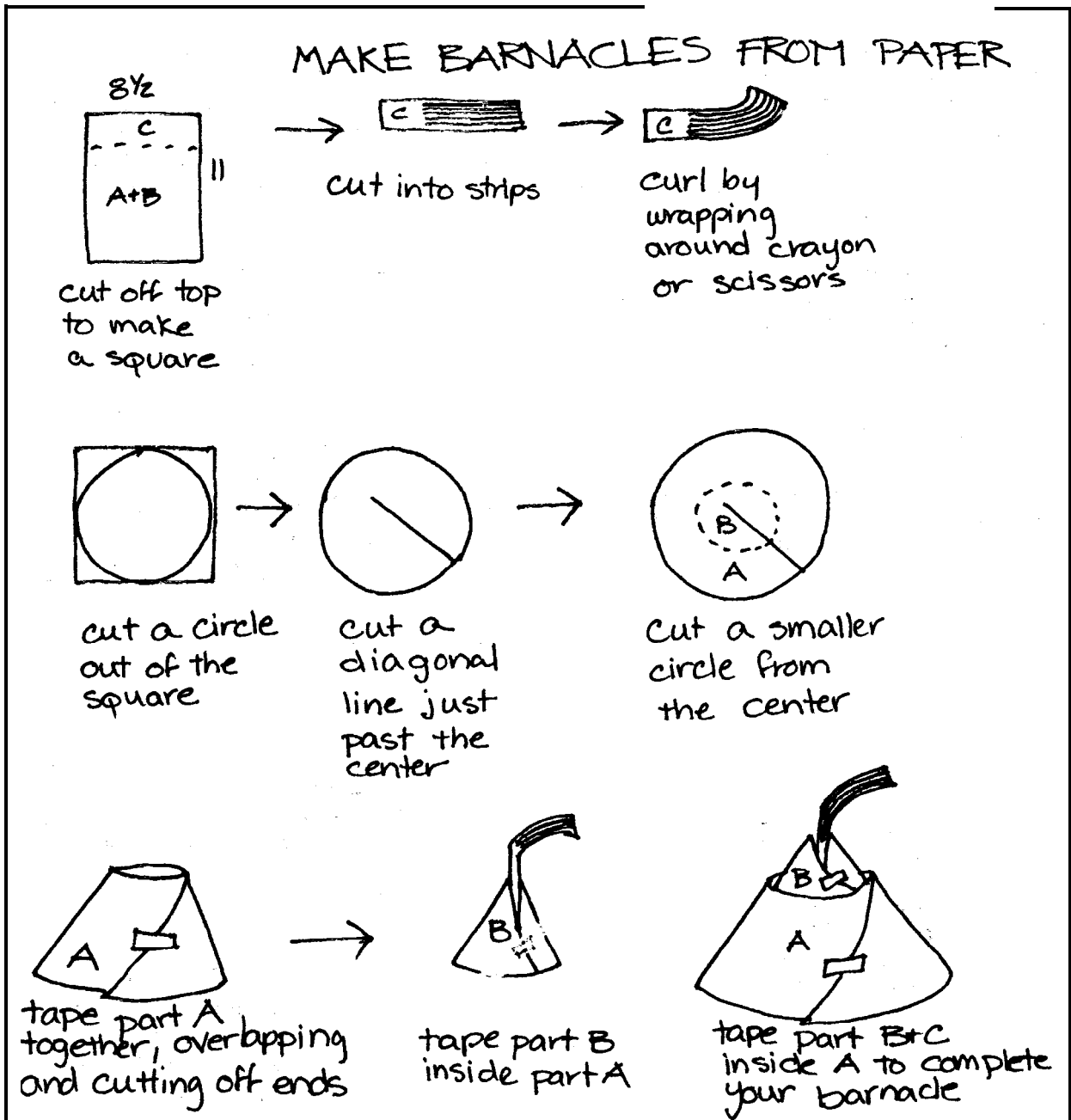
### Materials:

- pictures of crustaceans from books and magazines
- chalkboard or butcher paper
- chalk or felt-tip markers
- live crustaceans
- worksheets
  - ... Crab (2-K)
  - ... Crab Cutout (2-L)
  - ... Shrimp (2-M)
  - ... Shrimp Maze (2-N)
  - ... Barnacle (2-O)
  - ... Barnacle Math (2-P)
  - ... Amphipod (2-Q)
  - ... Sand Hopper (2-R)

**Additional activities:**

1. Language Arts : Write a class story or poem about what it is like to be a crab, shrimp, barnacle or amphipod.
2. Art, Science : Make barnacles out of paper.

3. Art : Make relief drawings of crabs. First sketch the crabs, then overlay with blue (for the ocean) and pink (for the crabs) tissue paper which has been dipped in liquid starch. Crumple extra tissue over the crabs for a relief effect. (Suggested by teachers at Badger Road Elementary, Fairbanks.)



Procedure:

1. Discuss the different kinds of crustaceans and how they live. Show the class pictures of crustaceans from books and magazines. Have students complete the worksheets: Crab; Crab Cutout; Shrimp; Shrimp Maze; Barnacle; Barnacle Math; Amphipod; Sand Hopper. (Barnacle Math was contributed by Larrv Trani, Baranof Elementary, Sitka.)
2. Ask students if they know how different kinds of crustaceans move. If possible, obtain live ones for them to watch. Crabs should be kept cool (in the refrigerator); for short periods they keep best out of water. Try feeding them pieces of fish, meat or shellfish. Be sure to return them to the ocean as soon as the class has had a chance to watch them.

Have the children imitate crustacean movements. They can try a "crab walk" on their backs on all fours, with faces and bellies facing up. They can also demonstrate how a crab walks by crossing their hands at the wrist and moving their fingers as if they were walking forward, backward and sideways. For sideways movement, the fingers of one hand pull as those of the other hand push.

3. Review with students the short finger play from the introductory Sea Week volume:

Words

I am a little hermit crab  
Looking for a shell

I see one . . .  
Here I come!

This one suits me very well.

Actions

Fingers of one hand creep across desk or table.

Cup the opposite hand a short distance in front of the creeping fingers.

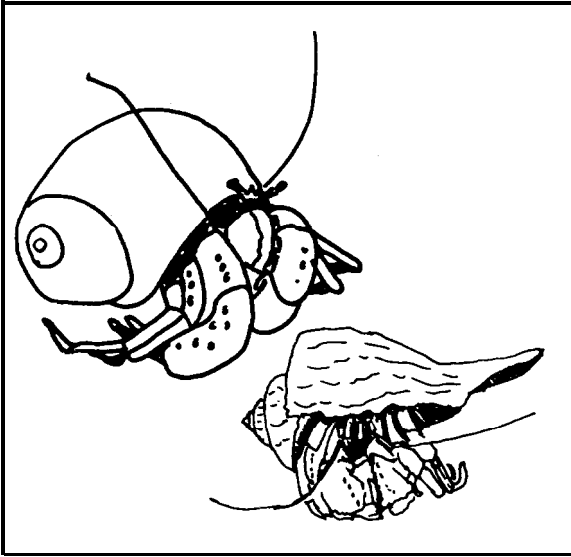
The creeping fingers jump inside the cupped hand.

4. Now invite the class to make up its own song with verses and motions about the way the different crustaceans move and how they live. Have them use just their fingers, or their whole bodies. Change the words to a familiar song such as "Itsy, Bitsy, Spider," or "I'm a Little Teapot." Write the words on the chalkboard or on a sheet of butcher paper. Practice--then give a program for parents or another class.

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## Activity 5

### *Pagoo*, The Hermit Crab



#### Background:

Hermit crabs are members of the same group of crabs as king crabs. Both have only three pairs of walking legs and one pair of chelipeds (pincers). True crabs, such as Dungeness and Tanner crabs, have four pairs of walking legs plus a pair of chelipeds. Hermits, however, are a distinctive group of animals whose abdomens have been modified to take advantage of the protection afforded by abandoned snail shells and similar objects. The front of the hermit crab looks like that of other crabs, with antennae, stalked eyes, jointed legs and a body covered by an exoskeleton; but the animal's soft abdomen is long and usually curved. There are special hooks on the small appendages on the end of the abdomen. These are used to grasp the internal column of a snail shell.

Like other crustaceans, hermit crabs molt. When they grow, they often must move to larger snail

shells. When the crab locates a new shell it likes, it releases the old shell and backs into the new one.

On the beach, the hermit crab may be found in tidepools, on sandy stretches or among cobbles. While examining snail shells, children may be startled to find one sheltering a retreating hermit crab, intent on withdrawing as far as possible inside to protect itself.

To introduce students to hermit crabs, use the book Pagoo, by Holling Clancy Holling. It is the story of one small hermit crab's trials, tribulations and encounters with other sea creatures. Accompanying the narrative are accurate, detailed drawings that present every kind of marine plant and animal life in the world of Pagoo, whose name comes from the genus Pagurus to which he belongs.

#### Vocabulary:

- . hermit crab
- . abdomen
- . jointed legs
- . antennae
- . habitat

#### Materials:

- . Pagoo, by Holling Clancy Holling. Houghton Mifflin Co., Boston, 1957. 87 p.
- . filmstrip or 16 mm film, "The Making of Pagoo"
- . worksheet
- ... Pagoo (2-S)

#### Procedure:

1. Pagoo is 87 pages long and can be read over a five-day period or told to the class as the pictures are shared. Through Pagoo, students will learn not only about hermit crabs, but

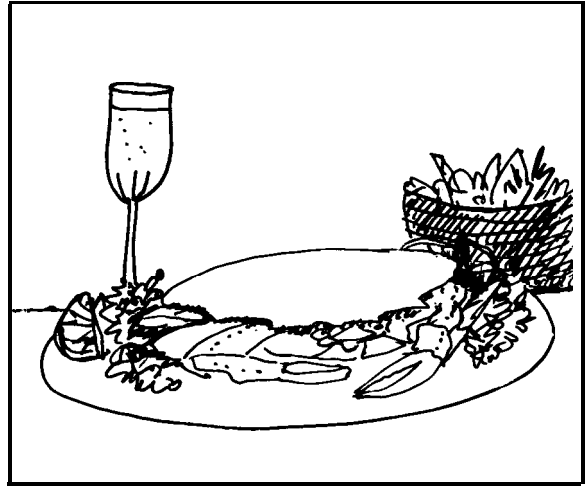


also a great deal about the ways in which other marine plants and animals live and interact with each other.

2. Show the filmstrip or movie of Pagoo to the class if either is available in your library.
3. Follow up the reading of Pagoo and the viewing of the filmstrip or movie with discussion and with any of these related activities:
  - a. Ask children to draw pictures of Pagoo in his world.
  - b. Write a class story about a hermit crab living on your own beach.
  - c. Write and illustrate a short story about another sea creature.
4. Use the worksheet on Pagoo to review hermit crab habitat. Hermit crabs need lots of shells, don't they? Remind the children that when they visit the beach they should leave a few shells for the hermit crabs!

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## Activity 6 Crab for Dinner



### Background:

Eating crab in class can be a learning experience as well as a treat. Three kinds of crab--king, tanner and Dungeness--are caught commercially in Alaskan waters. All three usually live in subtidal waters, but sometimes large kings can be found intertidally (in spring larger ones may come into shallow water to mate), and Dungeness of edible size may be found covered with sand in the lower intertidal zone.

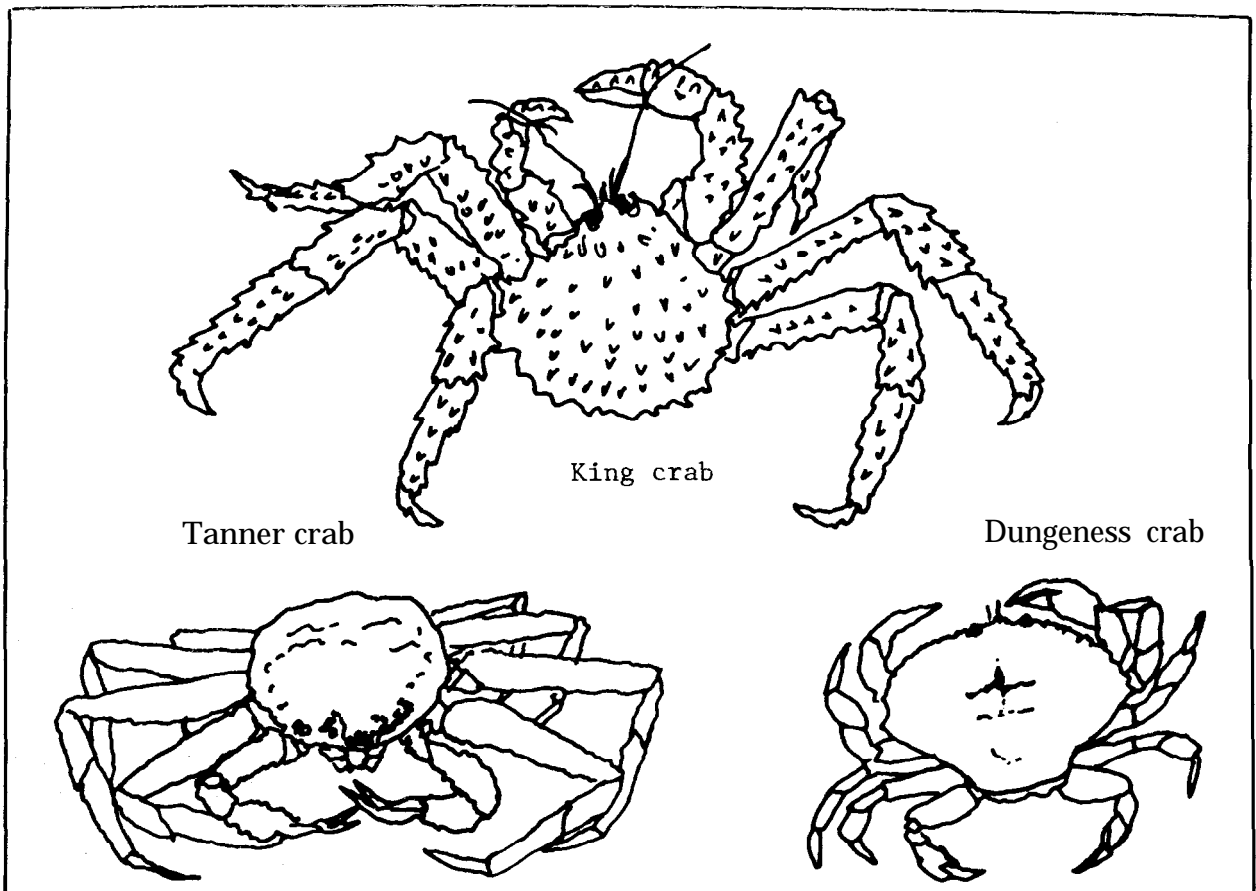
The KING CRAB is probably the best known of the Alaska commercial species. This is the largest of the Alaskan crabs and may reach a total width of more than four feet and a weight of more than 20 pounds. The best known is the red king (Paralithodes camtschatica). but blue (Paralithodes platypus) and golden king crab (Lithodes aequispina) are also caught and sold. As their common names imply, shell color separates the species; spination is also used to tell species apart.

The life history of the red king is well known. Eggs hatch in the spring, and the young drift in open water for about two months before settling to the sea floor. While drifting, they molt several times and begin to resemble adult crabs. When small, the young kings hide among rocks and algae to protect themselves. As they grow older, they join with other kings their own size, and often form large groups, or pods, that move over the sea floor like a living ball of red spines and tiny claws. At this stage, they have traded hiding for sticking together as a means of protection. As each crab continues to molt and grow, its size begins to afford it protection, and individuals move away from the pod.

With maturity, crabs follow another pattern. For part of the year they

live in deep water, but each year in late winter or early spring they move into shallow water to mate. Beginning in late winter, males seek out females and carry them in their claws until the female molts. They then mate and separate. The female's eggs are deposited under a flap beneath her body and are carried there for almost a year. The following spring, the eggs hatch and the cycle begins again. Some adult males also molt while in shallow water, but these will not mate while their shells are soft.

Kings are easily identified by their size and by the spininess of their shells. No other commonly found crab has well-spaced conical spines over its back and legs. The king has six walking legs and two claws, the right claw larger than the left.



DUNGENESS CRAB spend a good deal of time buried in sand with only their eyes exposed, and sometimes they can be found still buried after the tide has gone out. Look for semicircular depressions in the sand, and dig carefully.

Dungeness are fast-moving, feisty animals that readily use their claws for defense if threatened. Because their grip can be painful, they should always be picked up by grasping the back of the body with one hand. Handled in this manner, the crab cannot reach the hand holding it.

Dungeness parts are easy to recognize. The shell covering the animal's back is almost semicircular along the front edge, and the back edge looks like three sides of a hexagon. The leg segments are relatively short and broad, and do not have spines. Dungeness have eight walking legs and a pair of claws.

TANNER CRAB, sometimes called "queen" or "snow" crab, are seldom found alive on a beach, but pieces of their shells may be common. Tanners are between Dungeness and king in size and shape. The tanner's eight legs are long and sprawling like a king's, but lack the latter's large spines. Its shell is brown when old, but pink when newly molted. The body is more or less oval, with a large spine extending forward on the outer side of each eye socket. Alaska has two species of tanner that are quite similar in appearance : Chionoecetes opilio and Chionoecetes bairdii.

#### Vocabulary:

- claw
- . joints
- . king

- . Dungeness
- tanner

#### Materials:

- pictures of the three commercially important types of crabs
- collected shell parts from each type
- live or frozen whole crabs (or some canned crab)
- crackers
- crab-cracking implements
- pot of boiling, salted water
- worksheets
  - ... Crabs (2-T)
  - ... Dungeness Crab (2-U)

#### Procedure:

1. If at all possible, obtain a live or frozen whole crab. Check grocery stores, local fishermen, restaurants or friends in Kodiak or other coastal communities. Otherwise, use pictures, the worksheets and canned crab to discuss the three kinds of commercial crab and to give students a taste of crab meat. Try to obtain shell parts of the three species, perhaps on your beach field trip.
2. Have students sort the crab pieces by kind (king, tanner, Dungeness) ; by body part (leg, claw, body) ; by segment (long leg segment, short leg segment).
3. If you are lucky enough to get a live crab, keep it cool until you bring it out for the children to watch how it moves and how it uses its claws and eyes. Examine the mouth parts close up. Hold it by the back and turn it over. Point

out the stomach flap, or tail, which tucks up beneath the crab. Your specimen may be male, with a narrow flap, or female, with a broad flap covering the eggs when the animal is brooding them. Gently lift up the flap to see the brooding place.

4. Talk to the children about our dependence on the sea for food. Have a crab lunch. If the crab is whole and raw it may be cooked just as is, but many people find the taste better if it is first cleaned.

To clean: cut with a knife on the softer underside and pull the appendages (as a unit) off one side, inward and away from the carapace (the shell covering the animal's back). Then do the same for the appendages on the other side. Shake each half of the crab well, and pull off the leaf-like gills. Cut off the crab's tail flap and save it to eat with the rest.

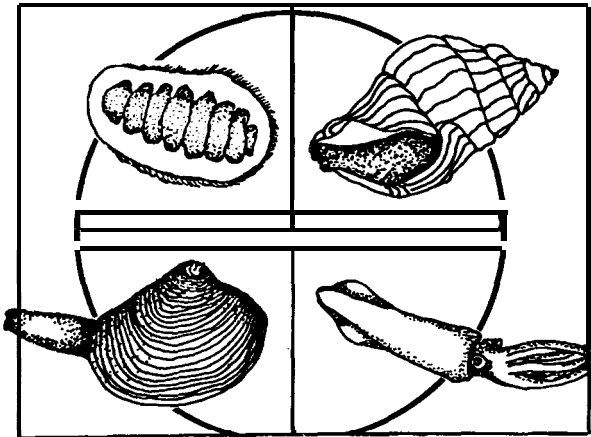
To cook, get a pot of salty water (sea water is best). Cook for 12-15 minutes after the water has returned to a boil. Eat while the crab is still warm.

While students are breaking the shell pieces and picking out the sweet crab meat, they can also be learning:

- . Point out how hard the shell is. If you have more than one crab, see whether the shells on both are equally hard.
- . Count the number of sections in each leg and each claw.
- . Work the joints of the legs and claws to see how they move. Think about how the claws work.
- . As the crab is cracked, look at the color of the skin on the meat (brown on Dungeness, red-orange on tanner and king). Explain to students that this is the new shell starting to form. If the crab is close to molting, the skin may be thick and rubbery and should be peeled off before the meat is eaten.

If you are eating meat from more than one kind of crab, have students describe the differences in taste and texture.

**Activity 7**  
**The Mollusks-**  
**Bivalves, Univalves, Chitons,**  
**Octopi and Squid**



Mollusks are a large and diverse group of soft-bodied animals which usually have a prominent shell and a thick, muscular foot. The shell may be a spiral covering the whole animal; it may consist of one, two, or several parts; it may be internal, or altogether absent.

**UNIVALVES** are mollusks having one part, or valve, to their shells. They belong to the class **Gastropoda**, which is the largest class of mollusks. Snails, limpets (sometimes called Chinamen's hats because of their conical shape), and abalones are examples of univalves. The mantle, a part of the soft animal which enlarges as the animal grows, secretes the shell. In the case of snails, the shell spirals around a central column; its opening is always at the widest part of the shell and is the starting place for new growth.

Univalves generally have well-developed heads and sensory capacities because they must search for their food. Some, such as limpets, are grazers that scrape their food from rocks with a tooth-bearing,

striplike structure in the mouth called a radula. Others, however, inject their prey with poison or feed in other specialized ways.

The eggs of many univalves may be found in clusters on beaches. Masses of eggs often are laid in different kinds of cases, some of which look like bent corncobs or oat grains, others like collars, tiny doughnuts, or groups of glassy beads. The larvae hatch as tiny swimming animals that will live in the ocean until they mature.

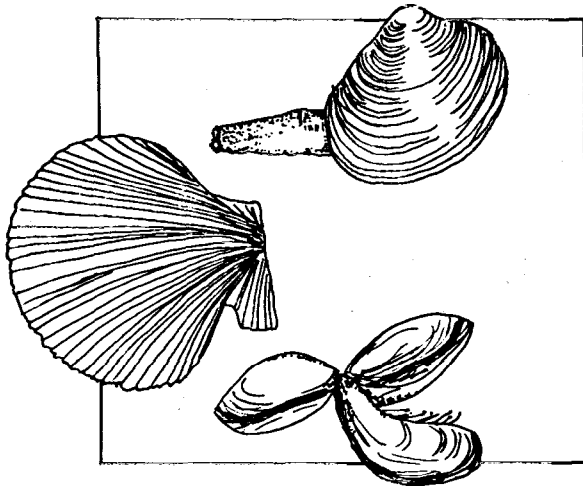


**SEA SLUGS**, or nudibranchs, are gastropods without shells. These soft animals may be mottled, dotted or striped in browns, yellows, reds, purples or combinations of colors. Often, elaborate branched or finger-like structures on their backs add to their striking appearance and serve as gills for gas exchange. They range in size from a fraction of an inch to more than a foot in length, but the animals found intertidally are generally small--sometimes small enough to be overlooked.



Sea slugs usually are specialized feeders and often may be found on their prey. Some eat barnacles. Others eat anemones and other cnidarians, and can store their prey's stinging cells in the structures on their backs for protection. One species of sea slug has a rounded hood that it uses to sweep the water for food.

Sea slug eggs usually are laid in gelatinous ribbons resembling the extrusions of a cake-decorating tube.



**BIVALVES** such as clams, cockles, mussels, oysters, and scallops are mollusks having two parts--or valves--to their shells. The shells are fastened together by a hinge. Muscles control their opening and closing, but the elastic fibers of the hinge ligament pull the shells apart. The soft animal inside the protective case usually has a much reduced head, but may have a well-developed foot for digging. Bivalves may live buried in sand or mud, or embedded in wood or sedimentary rocks (clams); or firmly attached to a hard surface (mussels); or unattached and unburied (scallops).

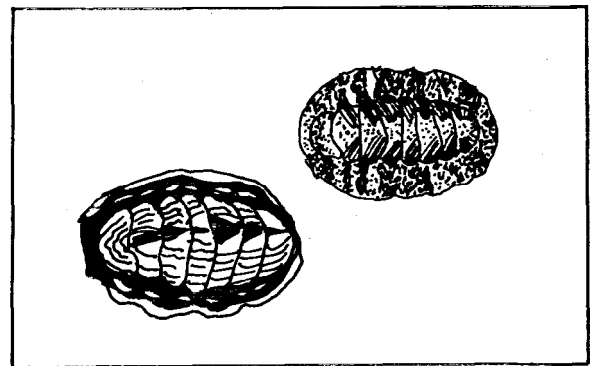
Unlike univalves, which actively seek food, bivalves are filter feeders. They pull water into their

bodies (often with an incurrent siphon), strain microscopic food out of the water, then expel the water through an excurrent siphon. Some bivalves are deposit feeders, and utilize the organic material associated with sediment.

Among bivalves, sexes usually are separate. Eggs and sperm usually are released into the open water. Bivalves never produce egg cases as univalves do.

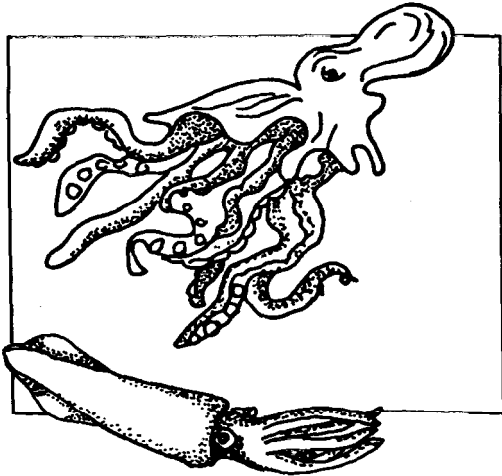
**CHITONS** are mollusks with eight overlapping valves to their shells. They are flat animals, usually found clinging tightly to rocks. Their ability to conform to a surface and fasten tightly makes them well-suited for intertidal areas where there is often strong wave action. Like limpets, they feed by scraping food from rocks.

Many kinds of chitons live in Alaskan waters, and they can be distinguished by the color patterns on their valves and on the girdle surrounding the valves. They range in size from species that never grow longer than an inch to a large red chiton that may be more than eight inches long.



Sexes are separate among the chitons. Eggs may be laid individually, in cases, in gelatinous masses, or may be carried by the female.

CEPHALOPODS, which include octopi and squid, are probably the most intelligent invertebrates. They have well-developed heads, relatively large brains, and are quick and active. Their eyes are similar to our own.



Octopi, with their suction ability, their eight disc-lined arms, and their sometimes awesome size of 100 pounds or more, have an undeservedly dangerous reputation. For the most part they are reclusive, hiding in dens that they leave only to forage for food such as clams and crabs. Although the octopus is capable of gliding silently and sinuously over the sea floor, it may jet away by using its siphon to expel water. If threatened, octopi and squid may expel ink to confuse predators. It was formerly believed that the ink formed a cephalopod-like shape that the predator would mistakenly chase, but more recent research indicates that the ink cloud may inhibit the predator's ability to locate the fleeing cephalopod by scent.

As is true of most cephalopods, one arm of the male octopus is modified for transferring sperm to the female (check for missing suction discs on one arm of the male octopus).

Females usually lay their eggs in protected places and tend them constantly as they develop. Females, who don't take time to eat while they are cleaning and aerating the eggs, usually die after the eggs hatch.

Squid vary in size, from the legendary giant squid to the tiny, bottom-dwelling squid found in Alaska, which is never more than a few inches long. Squid have 10 arms, two more than octopi, and they often have a flap-like projection on either side of the body covering or mantle. While octopi have no shell, squid have a thin, flexible, transparent or translucent internal remnant of a shell. Unlike octopus eggs, which are usually tended by the female, squid eggs are left to develop on their own and have a chemical characteristic that discourages other sea animals from eating them.

#### Vocabulary:

- . univalve
- . bivalve
- . mollusk
- . limpet
- . snail
- . clam
- . cockle
- . mussel
- . scallop
- . chiton
- . sea slug
- . octopus
- . squid
- . cephalopod

#### Materials:

- pictures of mollusks in books and magazines
- shell samples
- construction paper or cardboard
- scissors

- butcher paper
- pencils, crayons, or felt-tip
- markers
- masking tape
- mollusk shapes
- worksheets
  - ... Snails (2-V)
  - ... Clams, Cockles, Mussels, and Scallops (2-W)
  - ... Mollusk Count (2-X)
  - ... Mollusk Math (2-Y)
  - ... Octopus Cutout (2-Z)
  - ... Mystery Mollusk (2-AA)

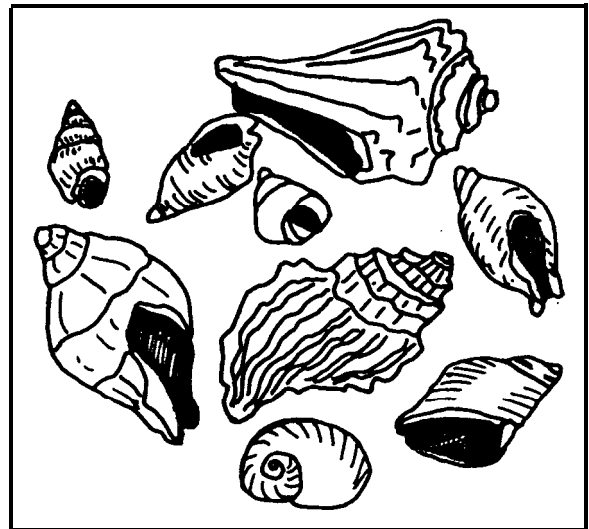
**Procedure:**

1. Put samples of the different mollusks on a table for the children to see and touch. Cut out the shapes of the mollusks for which you lack examples (e.g., octopus, squid, sea slug). Discuss the different types and show the children pictures of mollusks from books and magazines.
2. Have the class complete the worksheets: Snails; Clams, Cockles, Mussels, and Scallops; Mollusk Count; Mollusk Math; Octopus Cutout; and Mystery Mollusk. (Mollusk Math was contributed by Kathy Amerman, Maureen Coon, Kathy Dill, Mae Dunsing, and Larry Trani, Baranof Elementary, Sitka.)
3. Make mollusk matching puzzles. Divide students into groups of two or three and give each group a piece of butcher paper; crayons, pencils or felt-tip markers; masking tape and 15 different mollusks--cardboard cutouts or shells. Have students trace the mollusk shapes and write arithmetic problems (e.g. 3+4, 5-2)

on the butcher paper. Then have them write the answers on masking tape and stick these to the undersides of the mollusk cutouts. After the members of each group are finished, have them exchange their puzzle with another group--and see how fast they can match the tracings with the shells or cutouts. They can check their answers by doing the math problems!

**Additional activities:**

1. Math, Science : Have students measure their shells and cutouts and make bar graphs using these measurements.
2. Science, Language Arts : Bring live univalves or bivalves into the classroom for a brief showing. Have the class write a story about how fast they move, how they bury themselves, how they feed. Keep the animals cold (in the refrigerator) and take them back to their beach habitat as soon as possible, so that they can continue to fascinate future beach visitors.







3. Language Arts: Obtain a worldwide variety of shells from students or local collectors. Let each child select one and develop an imaginative oral or written story about it. These questions may help them:

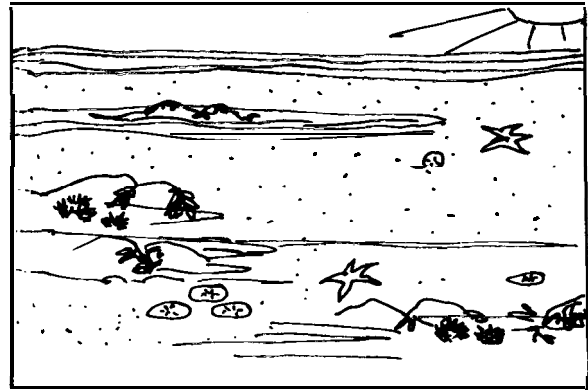
- . Where did you find your shell?
- . What were you doing when you found your shell?
- . Why did you select this particular shell?
- . What do you know about your shell and the animal that lived in it?
- . Give your shell a name!
- . Think carefully and find a name that fits.

(Suggested by Joanne Rogers, Paul Banks Elementary, Homer.)

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### Activity 8

#### The Echinoderms - Sea Stars, Sea Urchins, Brittle Stars, Sand Dollars, and Sea Cucumbers



#### Background:

Although it is not always obvious, the skeletons of the spiny echinoderms consist of tiny plates. Sometimes the plates form a recognizable "shell," as in the case of sea urchins; sometimes they are widely separated, as with sea cucumbers. Spines form part of the brittle armor of some animals, including sea stars, sea urchins, sand dollars and brittle stars.

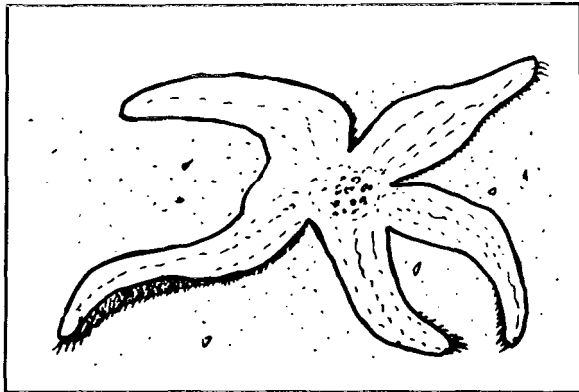
Radial symmetry is a distinguishing characteristic of this phylum. Like a pie, each echinoderm can be divided into similar wedges. Only among sea cucumbers is this difficult to see. To visualize a sea cucumber "pie," we must think of setting it on end before slicing.

In addition to their spiny appearance, skeletal plates and radial symmetry, all echinoderms have a water-vascular system that includes tube feet. These tiny, usually suction-cupped tube feet are linked to a system of canals that in most cases are in turn connected to a sieve plate through which water flows in and out of the

system. By muscular contractions and relaxation, each animal can attach or release the tube feet it uses for locomotion.

Most echinoderms release eggs and sperm into the open waters; the larvae swim freely until they mature and settle to the sea floor. Some sea stars brood their eggs under their arms, and small sea stars emerge from the fully developed eggs.

Sea stars and sea urchins often are abundant on Alaska shores. Sometimes sea cucumbers are plentiful too. Brittle stars are less often seen but may be found under clusters of other invertebrates. Sand dollars usually are subtidal, but sometimes their "shells" are washed ashore.

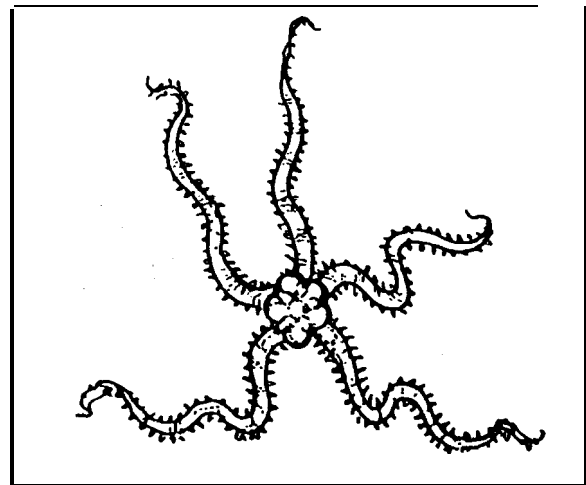


SEA STARS may be soft or stiff; many have five rays but several species have more. One species found in Alaska, the sunflower star (*Pycnopodia helianthoides*), develops new arms as it matures until it has 20 or more. Each of the many species found in Alaskan waters has distinct external characteristics separating it from other species. In general, however, major features of sea stars remain the same. All have an upper, or aboral, and lower, or oral, side. On the upper side there may be spines, tiny pincers, and micro-

scopic, finger-like structures, used for gas exchange. In the center area of the upper side is the sieve plate or madreporite through which water enters the vascular system.

A groove runs the length of each ray on the underside of the sea star. There are dozens of tube feet in each groove; the animal's mouth is located where the grooves converge. Examination with a magnifying glass may reveal at the tip of each ray a tiny eye spot; a light receptor that can give the star limited information about its environment.

BRITTLE STARS are like sea stars in many ways. Both are radially symmetric and have rays, a central mouth on the underside, and a system of tube feet. Brittle stars, however, have more snake-like rays than sea stars and move more sinuously.

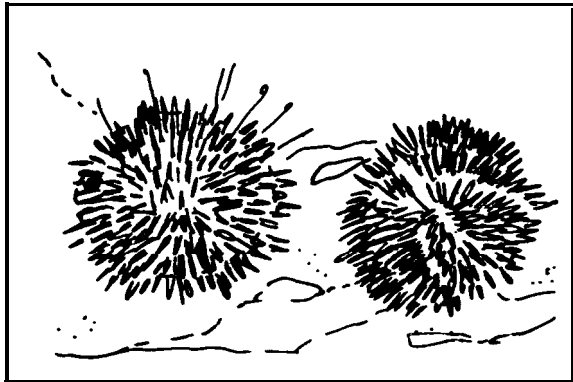


Brittle stars are so named because they readily shed pieces of their rays and even shed the central disc cap. Often these animals are found missing the terminal parts of one or more rays or with distinct areas of color change on rays, which mark the place where a ray has been regrown.

Many brittle star species are nocturnal, hiding under rocks, among kelp holdfasts, or in clusters of other invertebrates by day, and emerging to feed at night. Brittle stars are not often encountered intertidally but may be found tucked in some nook or cranny. Some brittle stars have pouches for carrying eggs at the bases of the rays. Others release their eggs and sperm into the water.

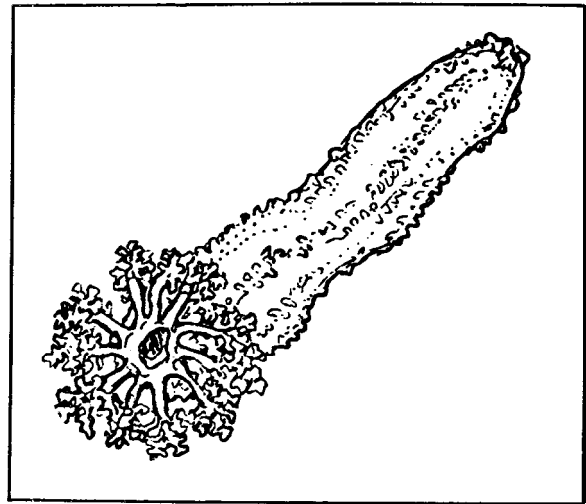
A number of species of brittle stars are found in Alaskan waters. One unique species, the basket star, Gorgonocephalus caryi, has dividing rays that form many tendrils to make it look like the mythical Gorgon's head with its writhing snakes for hair. The flesh-colored basket star lives subtidally and feeds by anchoring itself, then extending tendrils into the current to strain tiny drifting organisms or other food from the passing waters. Although they are not intertidal animals, basket stars are occasionally washed ashore.

Several species of SEA URCHINS live in Alaska's intertidal or shallow waters. Among them, the green urchin, Strongylocentrotus droebachiensis, is the most common. Red urchins, S. franciscanus, and purple urchins, S. purpuratus, may be found on rocky shores exposed to the open ocean.



Sea urchins look like living pin cushions. Externally they are covered with projecting spines, and among the spines are pincers and tube feet.

Like the other echinoderms, sea urchins are radially symmetrical and have a water-vascular system that includes tube feet, connecting canals and a sieve plate. To fully understand them, one must study both a living animal and the shell or "test" of an urchin. The test is a globular structure with a series of large and small knobs on which the spines articulate, and a series of pores through which the tube feet extend. The mouth of the urchin is a complex structure called "Aristotle's lantern." The sieve plate and the openings through which eggs or sperm are released into the open sea are on top of the urchin's test.

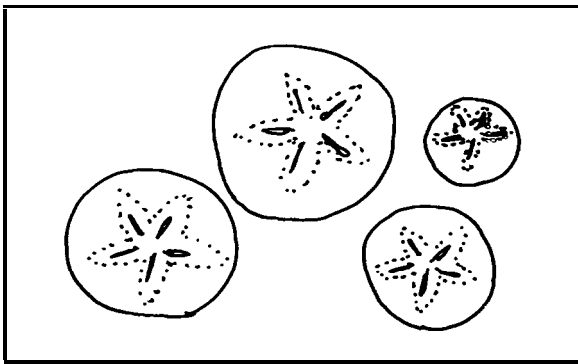


SEA CUCUMBERS, like other echinoderms, are radially symmetrical and have tube feet. Instead of being provided like urchins and sea stars with firm skeletal support, however, the cucumber has greatly reduced plates in the form of tiny "buttons" embedded in its skin. These give the animal its soft, "squishy" quality.

A number of species of sea cucumbers may be found on Alaskan shores. They range in size from the black, tar-spot cucumber (Cucumaria vegae) less than an inch long, to the large, edible Parastichopus californicus that may be more than 12 inches in length.

Some of the sea cucumbers live in crevices, some live under rocks, and some wander over the ocean floor, but most use a mop-like circle of oral tentacles to gather food. Typically, the tentacles extend to feed and are drawn one by one inside the animal and "licked clean" of food particles.

As a protective act when molested, some cucumbers have the peculiar habit of throwing all their internal organs out through the anal opening, or through a rupture in their body wall. Then, within 6-8 weeks, they regrow them.



The SAND DOLLAR is closely related taxonomically and by habits to the sea urchin. Like urchins, sand dollars have rounded, calcareous skeletons called tests. Tube feet are found on both surfaces of the test, and form a star-shaped pattern on the upper surface. Additional tube feet are found on both the upper and lower surfaces. Sand dollars are covered with soft spines, but these are absent from most specimens found on the beach-rubbed off by the surf.

Live sand dollars are usually found partially buried in the sand, where they search for their microscopic food. They use heavy particles (such as bits of gold) to help weigh themselves down, so many people have suggested mining them! If students find live sand dollars, tell them to replace them right side up, as some species can't turn themselves over without the help of the tides.

### Vocabulary:

- . spine
- . tube feet
- . sea star
- . brittle star
- . sea urchin
- . sea cucumber
- . sand dollar

### Materials:

- live sea star
- flashlight
- suction cup
- magnifying lenses or a binocular microscope
- pictures of echinoderms from books or magazines
- clay or Baker's clay (dough)
- toothpicks
- popcorn
- sand
- pipe cleaners
- tempera paint or glaze
- brushes
- blue butcher paper
- felt-tip markers
- worksheets

... Sea Stars (2-BB)

... Sea Star Dot-to-Dot (2-CC)

... Sea Star Cutout (2-DD)

... Sea Urchin (2-EE)

... Sand Dollars (2-FF)

... Sea Cucumber Crossword (2-GG)

## Procedure:

1. Sea Stars are the hardiest of the echinoderms and can survive short classroom visits. Obtain a live sea star and keep it cool in the refrigerator when you're not showing it to the children. Ask the children to:

- count its rays
- feel its texture (every species feels different)
- see if they can find its mouth
- feel the tube feet
- look in the mouth area and adjacent grooves for the commensal worms that sometimes live there, (doing no harm to the star, but profiting by the easy food gathering)

Demonstrate how tube feet work by using a suction cup. Mention that instead of having two feet like us, sea stars have hundreds that they must control. Some sea star species feed on clams and other bivalves, and with their tube feet they can apply a steady, pulling pressure on each half of the bivalve's shell, that eventually causes the mollusk's closer muscles to relax. Then the sea star extrudes its stomach between the halves of the shell, through openings as small as 1.0 mm. The star's digestive juices dissolve the bivalve's flesh, and the fluid food is taken in and absorbed by the sea star.

2. Have students look closely at the sea star with magnifying lenses or a binocular microscope. Place the sea star in salt water and shine a flash-

light on it. Have students watch for:

- the tiny eye spot at the end of each ray, which has limited sensory reception.
- a hard smooth spot on the upper surface of the sea star. (This is the sieve plate--or madreporite--through which water enters and leaves the system so that pressure in the tube feet can be maintained.)
- soft "fuzz" on the upper surface when the sea star is under water. (These are the "papillae," the respiratory structures that the sea star uses for breathing.)
- small pinching or grasping structures on the sea star's upper surface. (These scissorlike organs are used to keep the upper surface free of debris and of attaching marine plants and animals like barnacles. They can best be demonstrated by carefully placing a sea star upside down on the back of your lower arm where hair is abundant. After a few minutes, gently pull the sea star upwards and you can feel its tiny pincers! They are too little to do any damage.)

Be sure to return the sea star to the ocean as soon as possible.

3. Show the students pictures of other echinoderms from books and magazines and discuss how they live and grow. Have students complete the work-

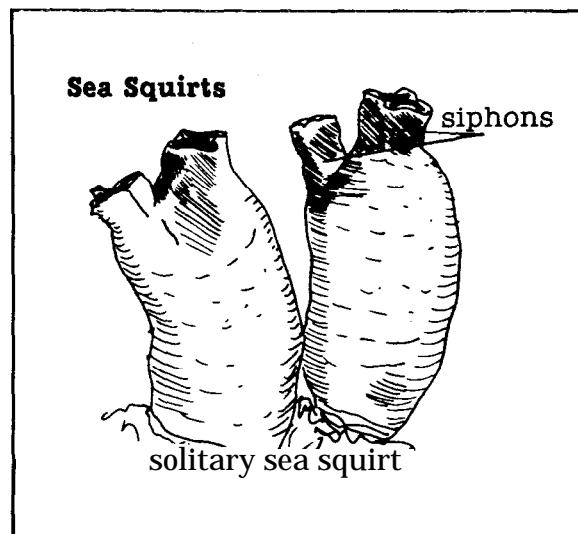
sheets: Sea Stars; Sea Star Dot-to-Dot; Sea Star Cutout; Sea Urchin; Sand Dollars and Sea Cucumber Crossword.

4. Have the children make three-dimensional models of echinoderms with clay or dough. To make:

Use toothpicks for the sea urchin spines; pipe cleaners for the brittle star legs; sand to make the sea star skin a little rougher; and popcorn on toothpicks for the feeding tentacles of the sea cucumber. The echinoderms can be painted with tempera paint or glaze, depending on whether dough or clay is used. After being baked or fired, they can be displayed on an ocean of blue butcher paper. Use a felt-tip marker to write labels or students' comments beside their models.

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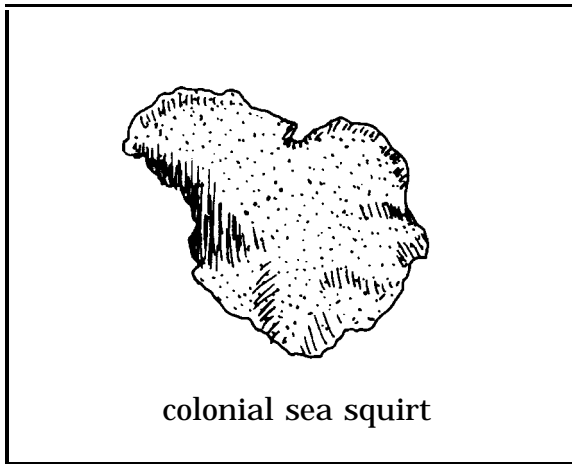
## Activity 9 The Chordates



SEA SQUIRTS are primitive chordates. This means they have a notochord, a rod-like structure in the back, as the chief internal skeletal support at some stage of their development. Most chordates are vertebrates. In vertebrates, such as snakes, birds, and humans, a backbone of bone or cartilage segments develops around the notochord during the embryo's development; the notochord itself then generally disappears (it persists in some fishes). Sea squirts only have a notochord in their early, larval stage. In adults, all traces of a spine have disappeared; that is why they are discussed here with the true invertebrates--animals with backbones.

The sea squirts may be translucent or opaque. Tan and orange are common in Alaskan sea squirts, but many other colors are found. Some sea squirts live as solitary animals that may be several inches tall, but others form flat or rounded colonies comprising numerous individuals. Their gelatinous texture helps to distinguish them from sponges.

Each sea squirt has two openings or siphons. Water comes in one siphon and goes out the other. The animal strains out tiny bits of food as the water flows through it. The ability to shoot water out through the siphon gives this animal its common name.



Both solitary and colonial sea squirts often are hosts to various animals such as sponges, mussels, amphipods and small tube worms.

#### Vocabulary:

- . sea squirt
- . notochord
- . chordate
- . vertebrate (review)
- . invertebrate (review)

#### Materials:

- . live sea squirt
- . pictures of sea squirts from books and magazines
- . chalkboard or butcher paper
- . chalk or felt-tip marker
- . worksheets :
  - ... Sea Squirts (2-HH)
  - ... Five Sea Animals (2-II)

#### Procedure:

1. Obtain a live sea squirt to show your students. Sea squirts are very common on some Alaskan beaches. Keep your specimen cold in the refrigerator. Let the students touch it and try to describe it.
2. Show students pictures of sea squirts from books and magazines.
3. Have the children complete the worksheet Sea Squirts.
4. Make a class chart on the chalkboard or on a sheet of butcher paper comparing sea squirts with the true invertebrates studied in this unit, using categories such as:
  - is larger than
  - is smaller than
  - is softer than
  - has more legs than
  - is more colorful than
  - is heavier than
  - has more tube feet than
  - moves faster than
  - has a bigger mouth than
  - has a smaller shell than
5. Have students complete the worksheet Five Sea Animals as a further review of the animals they have been studying.



# Unit Three

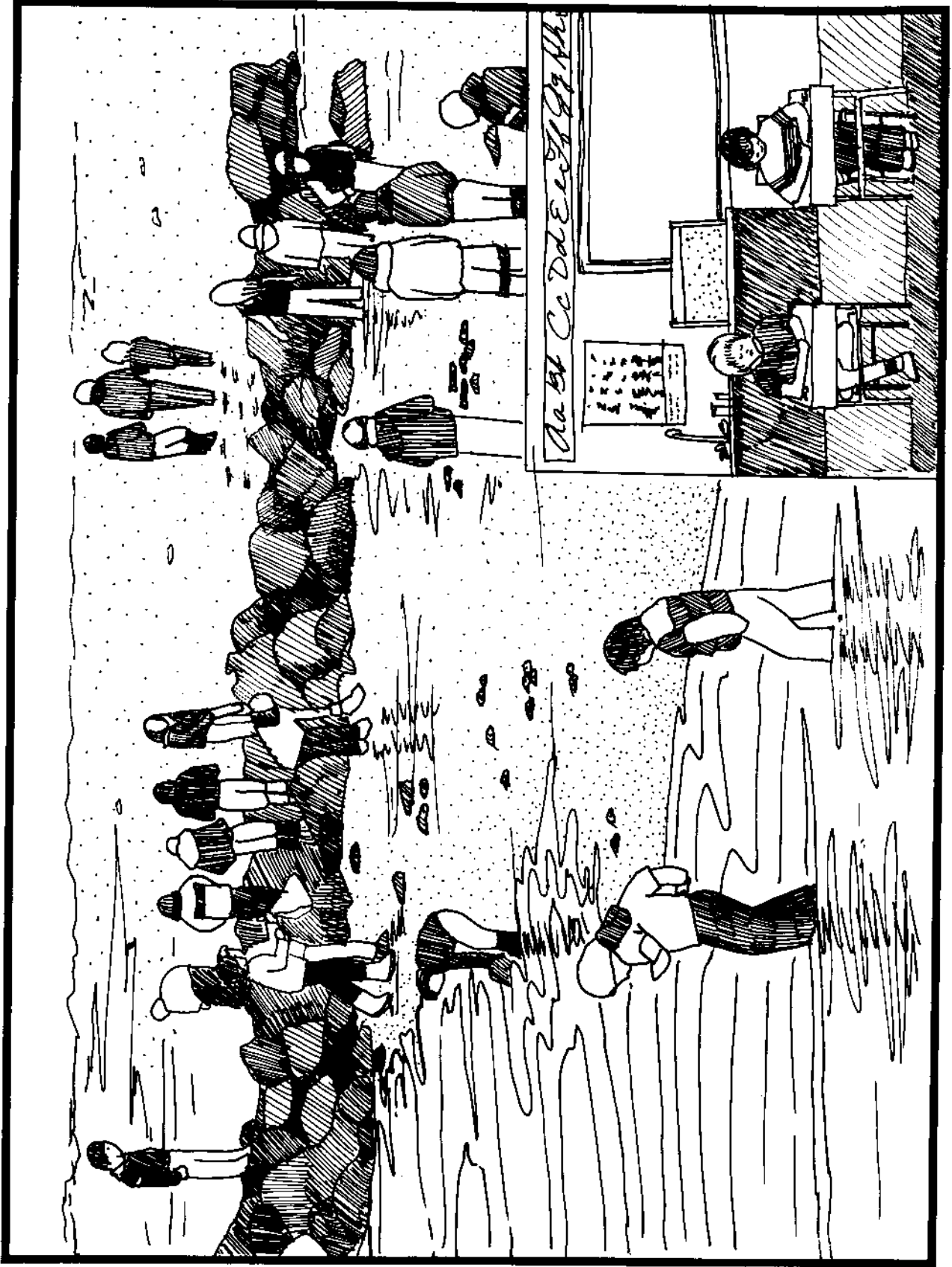
## Beach Field Studies

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### Objectives:

To help the student:

- . Learn that tides go in and out (Activities 1 and 2).
- . Practice safety procedures to avoid being caught by the tide (Activity 1).
- . Dramatize the differences in beach creatures' behavior at high and low tide (Activities 1 and 2).
- . Develop an awareness of proper care and respect for beach animals and their habitats (Activities 1 and 2).
- . Take a trip to the beach to explore pebbles, rocks, sand, seaweed, beach animals, sea sounds, and the sea itself (Activity 2).
- . Practice basic number concepts through counting barnacles, waves, pieces of driftwood, etc. (Activity 2).
- . Go on a beach treasure hunt and play beach games (Activity 2).
- . Create beach sculptures, a diorama and gifts from beach objects (Activities 2 and 3).
- . Sort and graph beach treasures (Activities 2 and 3).
- . Compose and sing sea songs; write and illustrate sea stories (Activity 3).



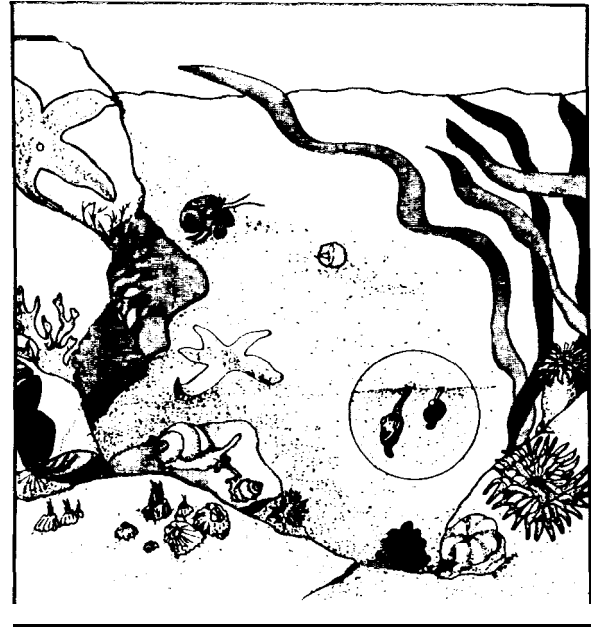
UNIT THREE: Beach Field studies. The excitement generated by a trip to the beach can be maintained with follow-up studies in the classroom.

Alaskan beaches are incredibly varied and fascinating. They range from jumbled boulders packed with invertebrates to mud flats or wind-swept sand, where only occasional invertebrates wash in with the tide.

Your students can be real explorers because very little is known about Alaska's coastline. Focus on the sea creatures (invertebrates, fishes, birds, marine mammals) and the roles they play in the total beach ecosystem. Include seaweed, plants, drift-wood, sand, mud, pebbles, boulders, waves and currents in your studies. Follow-up activities are included here and in the fish and marine mammals units later in the book.

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## Activity 1 When the Tide Comes In



### Background:

Tides, caused by the gravitational pull of the moon and sun on the oceans, are an intriguing and important factor of life along the coast.

The tide helps to shape the beach as it brings in waves and currents that move the sand, mud and rocks. It also has a tremendous effect on intertidal animals. Plankton comes drifting in with the tide to supply the many filter-feeding animals with nutrients. In order to survive in the intertidal zone, animals need to be extremely hardy: waves come crashing in; the hot sun dries the animals out; fresh water rain lowers the salinity level of the ocean; ice and freezing winter temperatures make life difficult; and pollutants often reach this area first because of waves and onshore currents.

Research by Gloria Snively at the University of British Columbia in Vancouver has shown that students, who generally see seashore animals stationary and closed up tight at low tide, often don't realize that they are alive and worthy of protection from rubber-booted feet. In order to help the children to realize that these are living animals and to better understand how they function in their habitats, have them act out the animals' behavior at high and low tide.

Another aspect of tides worth stressing is their inherent danger. Along with other elements of beach safety, students should be taught to take care not to get stranded by a high tide.

**Vocabulary:**

- . tide
- . tidepool
- . conservation
- . safety
- . danger

**Materials:**

- . local tide table
- . yarn, string or streamers
- . crayons
- . worksheets:
  - . ... High Tide or Low Tide?  
(3 - A) -
  - . ... Tide (3-B)
- . objects from the beach
- . paper bags
- . beach mural

**Procedure:**

1. Ask the students to tell you what they know about tides. Talk about the tides moving in. What happens to all the animals on the beach at low tide? (They pull in to try to

keep moist--and to protect themselves from being eaten. ) What happens at high tide? (They come out and feed and hang on tightly so that the waves won't wash them away.) Use the High Tide, Low Tide worksheet (adapted from Project Orca, Pacific Science Center, Seattle, Washington). Explain to the class that they may be able to see how these animals look at high tide by watching a tidepool. Fish, too, are frequently caught in tidepools, and birds often wait until the tide goes out for their daily feast.

2. Now have the class dramatize these creatures by pretending to be sea anemones, hermit crabs, barnacles (stand on your head and kick your feet), sea stars, sea urchins and others at high and low tide. One child can be a fish dashing to and fro in a tidepool. Now a gull, flying about, spies the fish. Does he catch it?
3. This is a good time to ask the children how they can help take care of these animals when they go to the beach. Children will seem like giants to the small shore animals. With the students' help, make a list of rules. You might include: stepping softly; handling any animals carefully and gently; turning rocks back over (keeping the roof on); filling in mud holes (if you dig for clams) so as not to hurt the animals "next door"; and not taking live animals away from their beach homes. Talk about "conservation"--the wise use of the

beach--and about leaving the beach cleaner than you found it. It is likely that the students will be more responsible at the beach for having helped to make the rules.

4. Talk about the power of the tide. What might happen if someone walked far out on a mud flat and the tide started to come in? Use the Tide worksheet. Have the children color the picture at low tide "when the water is all the way out." Have them draw pictures of themselves on the beach looking at sea creatures. Then, using a blue crayon or pencil, lightly color in the water to where it would be at high tide. What would happen to their lunch? What would happen if the students had been playing at the base of a cliff?
5. Have students pretend that they are on the beach digging clams when the tide comes in, surrounding them with water. What should they do? (Call for help, blow a whistle, wave a scarf--use a stick or clam shovel to feel cautiously shoreward through the water.)
6. If you have a beach mural in your room, hang string or crepe paper across it. Use a tide table to move the string up and down your beach each day to aid the children in understanding tide movements.
7. Invite students to bring in treasures they found at the beach at low tide. Place the objects in brown paper bags and ask the children to take turns reaching inside, feeling and describing their finds.

## Activity 2 Beach Field Trip



### Background:

The most important part of Sea Week is giving children a chance to explore and discover sea creatures on their own. For areas with meager tidepool life, take a look at some outstanding features of the beach (waves, currents, sand, pebbles, beach formation) and at the birds, fish, marine mammals, seaweeds and shoreline plants. And watch out for that occasional jellyfish or sea star coming in with the tide.

An inland class can create its own beach on the classroom walls or in the hallways. Older students may want to prepare a beach for the younger ones, who can use animal cutouts and their imaginations to make the beach come alive.

To prepare for your field trip:

- a. Select a time and place. Local people knowledgeable about the area can help you decide. (Low tide would be best in the southern and

southeastern portions of the state that are affected by tide. Northwestern and northern Alaska have a tide of only six inches, which is affected by the wind and currents so that it is barely noticeable.)

- b. Invite one of these local experts to go with you. They'll be pleased to be asked, and will enjoy the day, too. But don't hesitate to go by yourself, if necessary. You don't need to be an authority on beach life to lead a field trip. Learn with the children!
- c. Write a letter to parents asking for permission form signatures and for their assistance with the field trip. High school students and bilingual or special education staff may also be able to help. Small groups with a ratio of one adult to five students are ideal.
- d. Plan your field trip time to include plenty of discovery time, structured learning activities, a snack or lunch, litter pickup, and a review of the day's activities. A beach book or checklist can be very useful (see My Beach Book, worksheet 3-C).
- e. Discuss your field trip plans with the group leaders, ideally visiting the beach ahead of time. Stress the importance of disturbing the animals as little as possible.
- f. Prepare the students for the field trip by discussing what they're likely to see and by developing observation skills

and safety and conservation rules as a class. Limit collecting to material for art and science projects. Overly enthusiastic gathering could quickly strip our beaches of their more intriguing life forms!

- g. Plan your beach follow-up (see Activity 3 in this unit. )
- h. Enjoy the trip! It will probably be the highlight of the year for your students.

#### Materials:

- beach
- several clear plastic shoe boxes, other clear containers or heavy-duty plastic bags
- task cards for volunteer helpers
- hand lenses
- student name tags
- coat hangers
- snack
- paper bags for each group of students for the treasure hunt
- worksheet:

... MY Beach Book  
(3-C)

1. Give students their Beach Book worksheets. Go over safety and beach rules.
2. When you first arrive, place a stick at the edge of the water as a marker. Ask students if the tide is moving in or out. How can they tell? (Check the marker after a few minutes. If the tide is coming in it will be starting to cover the marker. If the tide is going out, it will move away from the marker--and the beach will be soaked above the waterline. )

Ask them to find the highest point reached by the waves within the past day and night. Can they determine the highest spot the water has reached this spring (or fall)? Have the class guess where the water will be when you leave. Check your marker at lunch time and at the end of the day. See who guessed the closest.

3. After students have had some time for general exploration, have your volunteers help them with the task cards.

The children can take turns choosing them. Pick out the cards most applicable to your area. You may want to use some of the task card ideas informally and to make up some tasks of your own. It's best to observe the animals in their natural surroundings, but if no tidepools are present, set them briefly in a clear plastic box or plastic bag of salt water so that the children can observe them closely under high tide conditions.

### Task Cards

#### SEA CREATURE

Decide on a sea creature to make from sand or mud. Then make it!

#### BEACH CRIME

Look for evidence of a beach mystery. If you find a clamshell that's broken open--who dun it? If you find trash on the beach, or holes bored in a wooden dock--who dun it? Decide how the crime happened and how long ago, who the villain was and how it could have been prevented.

#### DIG, DIG, DIG

Dig a hole one foot deep. Collect everything you find in a pile. What living things did you find? What non-living things? Cover up your hole so as not to disturb the animals next door. (Limit this to one or two holes, so that you don't disturb the whole beach!)

#### SEA ANEMONE SPECIAL

Find a sea anemone and gently touch its tentacles. What happens? Feed it a bit of food (bread, mussel, clam) and watch what happens. How many anemones, of how many colors, can you find?

#### SHELL FIND

Have the children find as many kinds of shells as they can in three minutes. How many are univalves? How many are bivalves? Leave the shells on the beach for other children to find.

### SEA STAR PINCH

Find a sea star and place it upside down on the lower arm of one of the students for several minutes. What happens when the sea star is drawn away? (If the sea star has pincers, children will feel its tiny pinches when it is drawn away. The pincers are used to clean debris off the star's top surface.)

### BEAUTY CONTEST

Pretend you are judges at the International Tidepool Beauty Contest. Pick the first, second, and third place winners. Also pick the last place contestant - but don't hurt the critter's feelings by telling him or her the results!

1st \_\_\_\_\_  
2nd \_\_\_\_\_  
3rd \_\_\_\_\_  
LAST \_\_\_\_\_

### CLAM DIG

Dig up a clam and set it back down on the sand or mud. Watch it for a while. How long does it take to start burrowing back into the sand? How does it move? (Be sure to refill any clam holes you dig! )

### EXPLORE A ROCK

Stand in front of a rock face. Close your eyes. Reach slowly up, down and sideways with your hands. Think about everything you feel, taking time to explore the area slowly and completely. Are there changes in texture, moisture, slope? Describe to others how the rocks felt and what you thought about as your hands explored them.

### SAND SIFT

Sit in a sandy area and close your eyes. Run your fingers through the sand. Is it dry or wet? Are the particles all the same size or are they different sizes? Do you feel any larger objects? Are they living or non-living? Can you describe them with your eyes closed?

### SEA SOUNDS

Sit by the shore with your eyes closed. What do you hear? Is the sea silent or noisy? Do sea sounds come and go or are they continuous? How would you describe the sound of the sea? Do birds add their sounds? Guess what kinds of birds you are hearing. Can you imitate them?



### BAREFOOT

If the day is warm, walk barefoot in the sand or on the warm rocks. Describe how it feels.

### TASTE TREATS

If your beach site is free from polluting influences, taste the sea. Is it really salty? With someone along who knows local marine life, taste sea lettuce, raw sea urchin eggs, or edible land plants that grow at the edge of the sea. Describe how each tastes.

### BARNACLE FEED

Find barnacles in a tidepool and watch them eat. Can you stick your tongue out and back as fast they can?

### WORM SQUIGGLE

Find a worm. What is it doing? Squiggle your body like the worm does!

### MUSCLE UP

Find a blue mussel. Can you see the golden threads it makes so that it can hang on to rocks? Show your muscle. How do you hang on to rocks?

### CRAB WALK

Practice a crab walk, using your hands and feet and facing upward. Now try making just your hands walk like a crab. Cross them at the wrists and move your fingers as if you were walking forward, backward, and sideways. See how the fingers of one hand pull and those of the other hand push--just the way a crab moves.

### SHELL SOUNDS

Find a large shell. Hold it up to your ear. Can you hear the ocean?

### SNAIL RACE

Find some snails and have a snail race. Now find a friend and have your own snail race. How fast can you crawl?

### CRAB MOLT

Look for an empty crab shell. Did the crab die or did it merely shed its shell (molt) so that it could grow a bigger one? (If it shed its shell there will be a slit-like opening where it backed out. Save some crab shell parts for later studies in your classroom.)

### WORM TOUCH

Touch a feather duster (tube) worm. What happens?

### HERMIT CRAB WALK

Hold a hermit crab gently in your hand. See if you can hold it still enough for it to come out.

### PEBBLE FIND

Find two beach pebbles exactly the same size. Find a flat pebble. Find a round one and a square one.

### BARNACLE SOUNDS

Listen to the barnacles. Can you hear them?

### SEAWEED SMELLS

Pick up some seaweed and smell it. What does your nose tell you?

### SAND HOPPER SWIM

See if you can find a sand hopper in some seaweed. Put it in the water and watch it swim.

### BEACH COUNT

Count the number of waves. How many clouds are in the sky? How many pieces of driftwood are on the beach? How many barnacles? How many grains of sand?

### SEA STAR SEARCH

How many sea stars can you find? What colors are they? How many arms do they have? Touch their tube feet. (Don't force them if they're hanging on real tight!)

### CUCUMBER TOUCH

Touch a sea cucumber. Run your fingers along its side. Can you find its five rows of tube feet?

### URCHIN WATCH

Find a sea urchin. Put it in a tidepool and see if you can see its spines move. Can you see its tube feet sticking up and waving around?

### SPONGE UP

Find a sponge. Touch it gently and leave it where it is. Can you find the little holes letting water in and out?

### DRIFTWOOD DRIFT

Have everyone find a piece of driftwood. Toss the wood in the water as far as you can. Which way do your floats go? Why? (If you can get them out far enough, you might be able to see the effects of the longshore current.)

### MARINE MAMMAL SIGNS

Do you see any signs that whales, walrus, seals, sea lions, sea otters or polar bears live in the ocean by your beach? Which kind of marine mammal do you think came by your beach most recently? What was it doing?

### ROCK MYSTERY

Find a rock on the beach. Turn it over carefully. What's underneath? Put your hand there. How does it feel? Now put your hand on the sand next to the rock. How does that feel? Do you know why some animals live under rocks? Now put the rock back carefully.

### WIND WATCH

Which way is the wind blowing? Wet your finger and hold it up in the wind to help you decide. What other signs can you use to tell which way the wind is blowing?

### DRIFTWOOD STORY

Find a piece of driftwood. Look closely at it and try to figure out where it came from. How many sea creatures have watched this piece of wood going by? Tell us a story about your piece of driftwood.

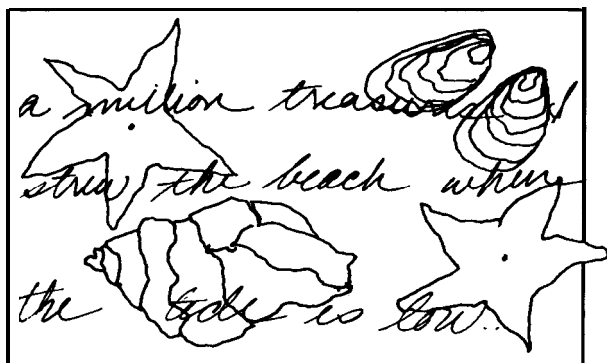
### FISH FIND

Can you catch a little fish? If you can, tell what shape it is. Why is it that particular shape? Put it in a container and watch it swim. How many fins does it have? Does it open and close its mouth? How does it breathe? (through its gills). Give a name to your fish. Then say goodbye and put it back in its home.

### SAND TRACKS

Find some tracks in the sand. Who made them? What was the animal doing when it made the tracks? Make some tracks of your own and see if your friends can tell what you were doing from looking at your tracks.

4. Collect a sand sample for the class to look at later under magnifying glasses or the binocular scope.
5. Do an "initial find." Have each student trace the outline of her first initial on the beach with a stick or pencil. With a flat stick or spoon scoop out everything within the boundaries of the initial to a depth of  $\frac{1}{4}$  inch. Have the children record their finds-- and then replace any tiny creatures found. (Contributed by Gerry Young, University Park Elementary, Fairbanks. )
6. Snack time. Children may need to build up energy or stand by a beach fire if it is cold or rainy.
7. Have a treasure hunt. The group leaders can check off items as the students find them so that they don't have to remove living things from their habitats. Sample items:
  - black snail shell
  - all the litter you can find
  - dry sand
  - something brown
  - something red
  - something with spines
  - green plant
  - dried up plant
  - clam shell
  - feather
  - driftwood



Give each group of students a paper bag with the list taped onto it. Keep the litter to discard afterwards!

- a. Have the class dramatize beach life. Practice being:
  - crabs scurrying across the sand
  - eagles soaring
  - gulls swooping over the ocean
  - waves coming in
  - anemones at low and high tide
  - sea stars eating blue mussels
  - hermit crabs moving to a new shell
  - seaweed waving in the ocean

Then put it all together as a dramatic scene and create a sea symphony with all the beach sounds!

9. Play a game of Clam, Clam, Chowder or Fish, Fish, Gull along the lines of Duck, Duck, Goose: The students sit in a circle and one walks around, tapping each child's head and saying, "Clam, Clam, Clam. . . Chowder!" At the call of "Chowder," the child caller and the student tapped as "Chowder" race around the circle back to "Chowder's" seat. The loser sits in the center of the circle until replaced by another child, and the winner becomes "It" for the next round.
10. Have races in which students mimic different seashore animals: clams, crabs, octopi, anemones, limpets, hermit crabs, sea urchins, jellyfish, worms, beach hoppers, gulls, fish.

11. Limit each child to one treasure (non-living) as a remembrance of the day (save a few for absent children). Plan follow-up art activities before you go to the beach, and collect as a class any materials you will need. Try not to take scarce items.
12. End the day with a review of what the class has seen and learned. Stand in a circle and have the children take turns saying what they liked best about the beach.
13. Sing a few sea songs on the way home.

### Activity 3 Home from the Beach



#### Background:

The beach visit works as a tremendous motivator, and after the field trip is an ideal time to capture the enthusiasm so that the students can work on their reading, writing, mathematics, social studies and artistic skills. Activities should depend on what you found at the beach and what the children are most excited about.

#### Materials:

- paper
- pencils
- crayons
- magnifying lens or binocular microscope and light
- glue
- beach treasures (one each)

#### Procedure:

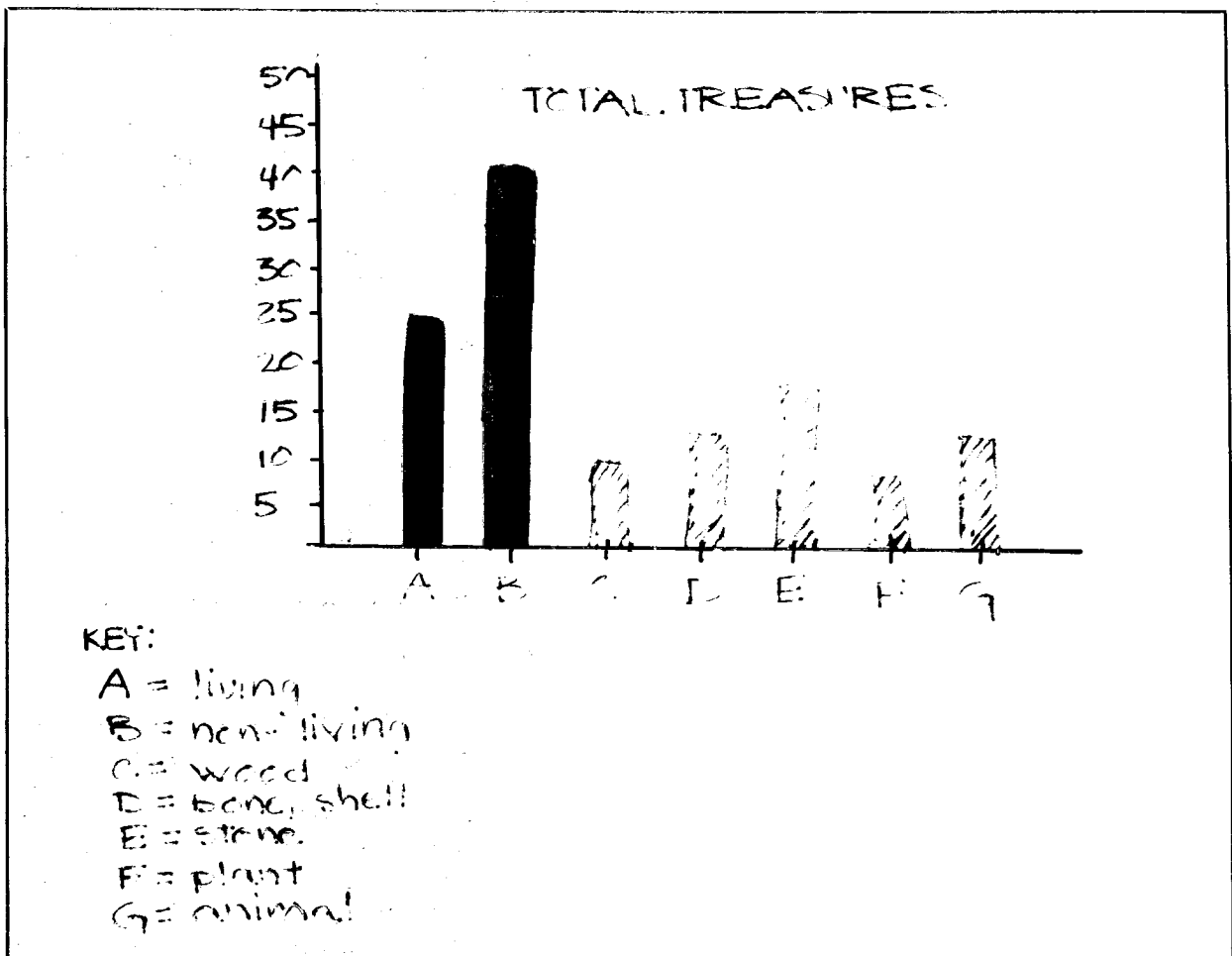
1. Ask the children to remember their day at the beach. What did they see, feel, taste, smell, hear? Have them draw pictures and write words or sentences to tell what they liked best. What did they like least? Would they like to go again?

- Examine your beach treasures. Have students empty their finds onto a large piece of paper. Tell them to sort the items into groups for a few minutes, then talk with them about these groups for about five minutes.

Return to sorting for another 10 minutes. The students may set groups up by size, color, composition (stone, stick, bone), shape, whether living or non-living, whether animal or plant, and other categories.

- Make a bar graph of the beach treasures.

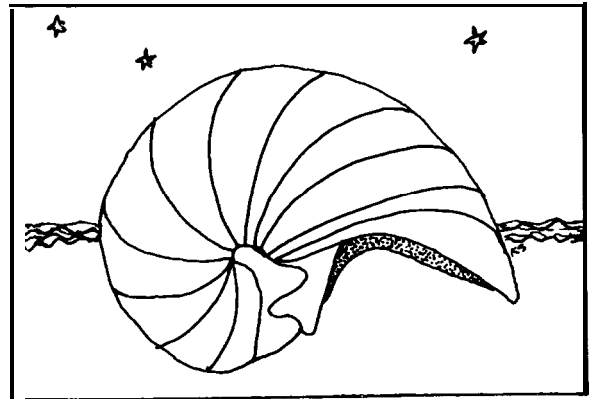
- Have the students further evaluate the treasures by telling why a particular item should be on the beach, how it affects others around it (does it offer shelter or create a sand dune?) or how it might be used by humans, birds or sea creatures. Use magnifying lenses or a binocular microscope to look at colors and textures. Look at beach sand under magnification. If you have any sand samples from other beaches, let the students compare them. Explain that the combination of rocks ground down to form sand is different everywhere. (Contributed by Gerry Young, University Park Elementary, Fairbanks.)



5. Discuss the tidepool beauty contest (on one of the task cards). Tally the first place contestants in the various groups, then the last place contestants. Ask the students how they made their last place choices. If the first and last place contestants ran off and got married, they would probably have some strange-looking offspring. Draw a picture of one of their children.
6. Out of shoe boxes or heavy construction paper make sea life dioramas of your day at the beach. (Contributed by Carol Deitz, Paul Banks Elementary, Homer.)
7. Make a present for someone in your family. Use driftwood, bark or cardboard for a base. Place some of your beach finds (shells, crab shells, pebbles, dried seaweed, driftwood) on the base until you have an arrangement you like; then glue the objects into place.
8. Make up an ocean song. Using the poem "Over in the


Meadow" by Olie A. Wadsworth, write verses using the names of sea animals for "Over in the Ocean" or "Over by the Seashore." Each student can make a page to illustrate one of the verses. Then combine the pages into a class book. See example on next page.

9. For another kind of class book: Ask students to draw and color pictures of their favorite sea animals. These pictures can be incorporated into a book along with a map of the beach and a description of the shore, of your trip, and of the treasures you found.




## Over in the Ocean

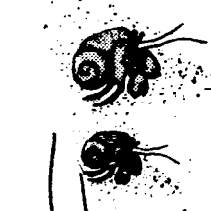
by Baranof Elementary School Students,  
Sarah Jordan, Music Teacher



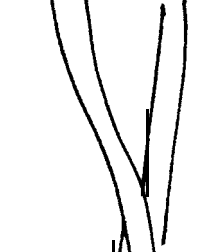
Over in the ocean, where the dolphins have fun,  
Lived an old mother whale and her little calf one.  
"Blow," said the mother, "We blow," said the one.  
So they blew and were glad where the dolphins have fun.



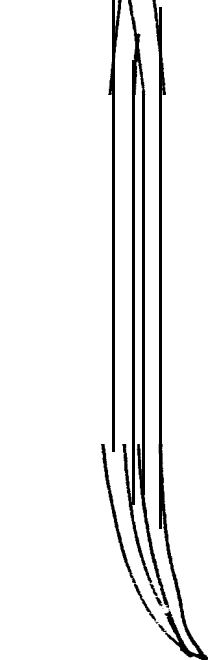
Over in the ocean where the eelgrass grew,  
Lived an old mother limpet and her little limpets two.  
"Crawl," said the mother. "We crawl," said the two.  
So they crawled and were glad where the eelgrass grew.



Over in the ocean where the tide runs free,  
Lived an old mother mussel and her little mussels three.  
"Stick," said the mother. "We stick," said the three.  
So they stuck and were glad where the tide runs free.




Over in the ocean on the ocean floor,  
Lived an old mother hermit crab and her little crabs four.  
"Pinch," said the mother. "We pinch," said the four.  
So they pinched and were glad on the ocean floor.




Over by the shore where the wild grasses thrive  
Lived an old mother goose and her little goslings five.  
"Honk," said the mother. "We honk," said the five.  
So they honked and were glad where the wild grasses thrive.




Over by the shore where the children throw sticks  
Lived an old mother halibut and her little halibut six.  
"Hide," said the mother. "we hide," said the six.  
So they hid and were glad where the children throw sticks.




Over in the ocean as high as heaven,  
Lived an old mother seagull and her little gulls seven.  
"Glide," said the mother. "We glide," said the seven.  
So they glided and were glad as high as heaven.



Over in the ocean where the king salmon ate,  
Lived an old mother sea urchin and her little urchins eight.  
"Poke," said the mother. "We poke," said the eight.  
So they poked and were glad where the king salmon ate.



Over in the ocean where the water and rocks shine,  
Lived an old mother shrimp and her little shrimp nine.  
"Paddle," said the mother. "We paddle," said the nine.  
They paddled and were glad where the water and rocks shine.



Over in the ocean with some diving men  
Lived an old mother duck and her little ducklings ten.  
"Quack," said the mother. "We quack," said the ten.  
So they quacked and were glad with the diving men.