



Teacher's Guide

Life on the Beach

Among Friends and Anemones

An Educational Video

This video provides an introduction to the ecology of Alaska's rocky intertidal zone and to ways in which people can use and protect the diversity of marine life on Alaska beaches.

It is geared primarily for classroom use by Alaska teachers (grades 4-8) planning a beach field trip. It introduces the concepts of intertidal zonation, adaptations to the variety of conditions that determine the distribution and abundance of plants and animals in the intertidal zone, and stewardship of Alaska's beaches.

Learning Objectives

Students will:

- Learn to identify common intertidal animals.
- Learn how to distinguish between mollusks, echinoderms, and arthropods.
- Learn how to identify the upper, middle, and lower intertidal zones on rocky beaches.
- Learn to describe examples of intertidal food chains.
- Understand that people depend on intertidal seaweeds and animals for food.
- Learn how to behave on beach field trips in ways that respect the environment and its inhabitants.

Alaska State Science Standards

A-12: Students will be able to distinguish the patterns of similarity and differences in the living world in order to understand the diversity of life and understand the theories that describe the importance of diversity for species and ecosystems (DIVERSITY).

A-14: Students will understand the interdependence between living things and their environments, and that a small change in a portion of the environment may affect the entire environment (INTERDEPENDENCE).

B-1: Students will use the processes of scientific inquiry, especially observation and classification.

Beach Zones

The variety, or *diversity*, of life on Alaska beaches often is distributed in distinct bands, or zones, of biological communities that parallel the shoreline. *Shoreline zonation* is most

distinct on the faces of large boulders or bedrock outcrops where the plants and animals that are adapted to life on the rocky *substrate* also are adapted to different levels of exposure to the tides. The communities on these rock habitats are very different from those adapted to live in soft-bottom substrates of sand or mud.

Some beaches are mixtures of rock outcrops, boulders, cobbles, and areas where sand and mud are deposited. Beaches with this mixture of substrate types support the largest number of different species, and therefore the highest *biodiversity*.

What Lives Where, and Why

Alaska's beaches are dynamic and often harsh environments for plants and animals. However, many species are uniquely adapted to live "between the tides." This section of shoreline, which is the area uncovered by the lowest tides and covered by the highest tides, is known as the *intertidal zone*. The distribution of plants and animals in the intertidal zone appears to be dictated by a combination of biological adaptations to physical conditions and to inter- and intra-species competition and predation.

Upper limits for plants and sessile (fixed) animals are generally set by their tolerance to physical factors, while the lower limits are often set by biological interactions.

The intertidal zone is progressively more crowded at the lower tidal levels where complex dramas are played out in competition for space and food and the avoidance of becoming food. For mobile animals, behavior often provides important adaptations that influence where they can survive.

The most important factors that determine the suitability of the different tidal zones as habitat for each plant and animal species are *tidal dynamics*, *exposure to waves*, *substrate type*, and *ecological interactions*.

Tidal Dynamics

The range and timing of tides are the primary controlling factors that dictate what kinds of organisms inhabit each zone.

The action of the tides moves the salt water's edge up and down the land in a predictable and regular sequence. When the tide is out, plants and animals in the higher part of the zone are exposed to drying (*dessication*) and extremes of heat and cold. But organisms that have adapted to survive these periods are again bathed in the rich "soup" of the ocean, or made buoyant when the tide returns.

Lower down in the intertidal zone, exposure to drying and temperature extremes occurs less frequently and for shorter periods. A greater number of species is adapted to these less stressful conditions.

Beaches in Alaska have a *semidiurnal tide cycle*, which means that two tide cycles occur over approximately 24.8 hours. The tide cycles are unequal, with a low tide and the following high tide higher or lower than the next series. Many areas have very large tidal ranges.

Exposure to Waves

Wave action can extend the intertidal zone even higher up on the land, and strong wave action on open coasts can sweep away whatever is not clinging or firmly attached.

Substrate Type: Rock, Sand, and Mud

Rocks of various sizes, from cobbles to boulders, provide plants and animals with a variety of niches (under rocks, in crevices and tide pools, on sides and tops of boulders) for potential attachment where the organisms can withstand the force of tides and waves and be sheltered from dessication and temperature extremes.

Animals that live on sandy beaches and mud flats must be adapted to burial by shifting sediments.

Ecological Interactions

In addition to physical factors, relationships between and among organisms also affect and often control survival at any specific site. These relationships are especially important in the lower intertidal zone where competition, grazing, and predation control the composition of the biological community.

Teaching Suggestions

If you are planning a field trip to one of Alaska's many beaches, showing this video is a good way to prepare students for what they are likely to find and to introduce or reinforce learning concepts. Spending time viewing and discussing the video before the field trip will get the kids excited about the excursion and will help you make the most of your exploration and observation at the beach. And if you can't get to a beach, the video and this teacher guide are still great resources for the classroom, home school, library, or interpretive center.

Before Showing the Video

Watch the video on your own before showing it to the children to familiarize yourself with the content. Review the following vocabulary used in the video.

Glossary

Arthropods: Animals with exoskeletons made of chitin; bodies segmented; segments usually carry a pair of antennae, mouth parts, legs, or other appendages.

Bidarki (ba-DAR-kee): Russian term for a small boat and common name for the boat-shaped katy chiton.

Biodiversity: The variety of living things. Can be measured at the species level (i.e., the number of different species) or at the genetic level.

Bivalves: Mollusks with two shells. Examples are mussels, clams, cockles, and scallops.

Camouflage: Ability to blend into surroundings so as to be difficult to see. A defense adaptation to avoid predation. It also is an adaptation used by predators to help conceal themselves from prey.

Crustaceans: Arthropods that include crabs, shrimp, and barnacles. Depending on species, they may graze, scavenge, or predate to get food.

Echinoderm (ee-KINE-oh-derm): “Spiny-skinned” animals with plates covered by at least a thin layer of skin. Body built in a circle with body parts in fives or multiples of five. Locomotion by a system of interconnected tubes filled with seawater.

Holdfast: A root-like structure that anchors some large seaweeds to the bottom on hard substrates, such as rocks.

Intertidal Zone: The zone between the high and low tide-water marks that is periodically exposed to air.

Mollusks: Soft-bodied animals, usually protected by one or more hard shells secreted by a specialized skin, called the mantle.

Nudibranch (NU-duh-brank): Sea slug group of gastropod mollusks.

Plankton: Organisms that are suspended in the water. They rely on water movements for distribution and transport. Plankton capable of photosynthesis are called phytoplankton. Animal plankton are known as zooplankton.

Radula (RAD-you-la): Rasping “tongue” with chitinous teeth unique to all mollusks, except bivalves.

Tentacles: Long, thin, feeding structures of anemones, sea cucumbers, and tubeworms, arranged in a circle around the mouth. Also, arms of octopus and squid.

Tube Feet: Appendages of the hydraulic locomotion system of echinoderms. Each foot is filled with fluid and attached to muscles that enable it to bend, and ends in a sucker.

Explain or review with the students the definition of the intertidal zone. Discuss the kind of place it is in terms of tidal movements; different kinds of “bottom” (substrate), including mud, sand, rocks of different sizes, cliffs, tidal flats; and how strong the waves are. Use pictures of different kinds of beaches from library books or magazines for illustrations. If any of your students have gone clamming or hiking at the beach, ask them to describe what the beach was like.

Ask students to describe the characteristics of mollusks, echinoderms, and arthropods (refer to glossary), and to watch for examples of each in the video. Tell them that most of the animals shown in the video are invertebrates (animals without backbones), except for six vertebrates.

Assign each student one of the “cast of characters” (listed on pages 10 and 11) in the intertidal zone. Ask them to look and listen for their character and to pay attention to which zone it lives in and how it is adapted to survive in that zone.

If you are showing the video before taking a beach field trip, explain that they will be hearing about ways they should behave on the field trip to avoid hurting the animals they will see.

After Showing the Video

1. Ask students to list the mollusks, echinoderms, arthropods, and vertebrates. (Vertebrates are the people, birds, bear, sculpins, sea otters, and Steller sea lion.)

2. Pass out copies of the blank “Tide Zone Handout.” Review the characteristics of each zone and the “cast of characters” that lives in each zone. Work as a class to write the names of each animal or plant in the appropriate zone on the diagram and draw a sketch of each organism next to its name.

3. If you are emphasizing classification, ask students to indicate which of the animals are vertebrates, and which of the invertebrates are mollusks, echinoderms, or crustaceans.

4. Discuss adaptations of each organism for staying wet, avoiding being washed away by strong tides or waves, finding and eating food, and being protected from getting eaten by predators shown in the video.

5. Review what the students have learned about the food chain connections for each species—including humans! Write this information on the board, and then break the class into smaller groups to create food chains and webs. For example, here are some short and simple food chains:

- Phytoplankton/zooplankton—filter feeders (e.g., sponge, barnacle, clam, mussel)
- Phytoplankton/zooplankton—clam—black bear
- Phytoplankton/zooplankton—mussel—true star or ochre star—sunflower sea star
- Phytoplankton/zooplankton—clam—human
- Phytoplankton/zooplankton—clam—hermit crab (scavenges dead clams)
- Phytoplankton/zooplankton—barnacle—sculpin (eats barnacle feet)—larger fish—bald eagle
- Seaweed—grazer (e.g., limpet, periwinkle snail, chiton, sea urchin)
- Bull whip kelp—sea urchin—sea otter
- Seaweed—bidarki/black katy chiton—human

- Seaweed—chiton—gulls and hermit crabs that scavenge dead matter
 - Sponge—nudibranch
6. Review the “beach etiquette” rules that were included in the video and why they are good ones to protect the life on the beach:
- Walk carefully and avoid stepping on living plants and animals whenever possible.
 - Handle intertidal animals carefully and replace them where they were found. Take care to gently replace any seaweed or rocks to keep the animals from drying out, being easily found by predators, or crushed.
 - Remove litter from the beach.
 - Obey laws concerning collecting or harvesting plants and animals from the beach.

Questions for Discussion

1. *Why do different animals live in different zones on the beach?* Review the different conditions in each zone and the adaptations animals possess to cope with the conditions.
2. *Why do more kinds of plants and animals live lower down on the beach, closer to the open ocean?* Exposure to air, direct sunlight, and highly variable temperatures are stressful to marine organisms. Intertidal areas closest to the ocean are covered by water for longer periods of time each day than are intertidal areas higher on the beach farther away from the open ocean. Water-covered areas provide a more constant, less stressful habitat because water temperature is relatively constant compared to air temperature. Plus, organisms covered by water for longer periods of time are less susceptible to drying out. Therefore the intertidal zone closer to the open ocean is a more hospitable environment and hosts the greater number of species.

3. *What is one advantage and one disadvantage of being attached to one spot, like barnacles and seaweeds?*

Advantage: They don't get swept away by the tide and food is provided by the tide if "the spot" is a good one. Disadvantage: They can't move if conditions are not good or change for the worse. (Note that many attached animals reproduce by dispersing planktonic [suspended] larvae that will settle somewhere else, perhaps in a more suitable spot.)

4. *Can you think of things that people do which might affect the plants and animals in the intertidal zone?* Examples:

Heavy use of beaches by lots of people who trample plants and animals; overharvesting shellfish or seaweed; oil spills or other pollution; leaving trash on beaches.

Cast of Characters

(in order of appearance)

Humans	Chordate
Sea Anemone	Cnidarian
Sea Stars	Echinoderm
Crabs	Arthropod/Crustacean

Upper Intertidal Zone

Barnacles	Arthropod/Crustacean
Plankton	Monerans
Snails	Mollusk
Limpets	Mollusk

Middle Intertidal Zone

Mussels	Mollusk
Clam Worm	Annelid
Hermit Crab	Arthropod/Crustacean
Rockweed	Brown Algae
Red Seaweed	Red Algae
Sea Lettuce	Green Algae
Sea Star	Echinoderm
Clam	Mollusk
Cockle	Mollusk
Steller Sea Lion with Salmon	2 Chordates
Black Bear with Salmon	2 Chordates
Bidarki/chitons, Katy chiton	Mollusk

Lower Intertidal Zone

Sea Star	Echinoderm
Sea Urchin	Echinoderm
Sea Otter	Chordate
Sea Cucumber	Echinoderm
Brittle Star	Echinoderm
Sponge	Porifera
Dorid Nudibranch	Mollusk
Bull Whip Kelp	Brown Algae
Sea Anemone	Cnidarian
Scallop (escaping sea star predator)	Mollusk
Mossy Chiton (camouflage examples)	Mollusk
White-Cap Limpet	Mollusk
Coralline Algae	Red Algae
Sculpin	Chordate
Gull	Chordate
Octopus	Mollusk

Extensions

1. Have each student research the plant or animal that was “theirs” during the video using the Internet or library books (see Resources section) and report back to the class.
2. Have the students invent their own invertebrate by deciding what it will eat, how it will eat, how it will move or attach itself to the beach, and how it will be adapted to avoid being eaten by predators. Have the students draw their invertebrate creation, and write down the adaptations their animal possesses next to the sketch. This can be extended with art supplies to build imaginary invertebrates.
3. Get a tide table book for the beach you plan to visit and have the students graph the high and low tides for each day of the month during which your field trip is planned. Ask them to mark the day of your field trip and discuss which of the zones will be uncovered at low tide on that day. Ask them to predict which animals they are likely to find.
4. Use the “Tide Zone Handout” as a reference to create a class mural of the intertidal zone.

Resources

From Alaska Sea Grant

www.uaf.edu/seagrant,
or toll-free, (888) 789-0090

Alaska's Aquatic Ecosystems. An interactive CD ROM that explains the different marine ecosystems with an emphasis on food webs and the organisms within.

Alaska Sea Week Curriculum. All six volumes in this series cover marine topics. The curriculum is geared for elementary grades, but handouts and materials are included that can be adapted for older students. These two volumes are especially relevant for beach field trips:

Animals of the Seas and Wetlands. By Belle Mickelson. Looseleaf, 154 pp.

Shells and Insects. By Claudia Kelsey, Mary Beth Parsons, and Peggy Cowan. Looseleaf, 169 pp.

Beach Explorations: A Curriculum for Grades 5-10. By Gloria Snively. 288 pp, plus a packet of species identification flash cards. Published by Oregon and Washington Sea Grant programs.

Beachwalk. By Madelyn Yerden Walker. Free brochure that describes how to prepare for and conduct a low-impact beachwalk. Also available as PDF file from the Sea Grant Web site.

Common Bivalves of Alaska. By Ray RaLonde. 11×17 inch poster that describes common Alaska clams, cockles, mussels, and scallops, and the threat of paralytic shellfish poisoning.

Surviving on the Foods and Water from Alaska's Southern Shores. By Dolly Garza. 23 pp. A handy booklet that describes wild edibles and how to get drinkable water on Alaska beaches.

Tlingit Moon and Tide Teaching Resource: Elementary Level. By Dolly Garza. 67 pp. Combines Alaska Native way of understanding shoreline ecology with Western science viewpoint.

North Pacific Seaweeds. By Rita O'Clair and Sandra C. Lindstrom. 160 pp. Published by Plant Press.

Walk on the Wild Side. 12 minutes. Video that describes how to conduct a low-impact beachwalk.

Guide to Marine Mammals of Alaska. By Kate Wynne. 75 pp. Color-illustrated field guide that describes each species of marine mammal found in Alaska waters.

From Other Sources

Alaska's Seashore Creatures. By Carmen and Conrad Field. 94 pp. Alaska Northwest Books.

Beachcomber's Guide to Intertidal Marine Invertebrates of Southcentral Alaska. Laminated field identification card for 90+ species. Northcountry Nature, P.O. Box 2551, Homer, AK 99603.

Who's Who in the Intertidal Zone? Atlas of 50 common marine invertebrate and seaweed species, with information on each species suitable for use in student research projects. 50 pp. Center for Alaskan Coastal Studies, P.O. Box 2225, Homer, AK 99603. (907) 235-6667.
www.akcoastalstudies.org/ Email: cacs@xyz.net

Life on a Rocky Shore. CD-ROM with 100 photos, graphics, video clips, and Teacher's Guide. Marine Science Society of the Pacific Northwest and Triton Productions.

Discovery Guide to Intertidal Animals of Southeast Alaska. By Katherine Hocker. Laminated brochure with more than 60 color drawings of invertebrates and seaweeds commonly seen in Southeast Alaska, arranged according to upper, middle, and lower intertidal zones. Discovery Southeast, P.O. Box 21867, Juneau, AK 99802. (907) 463-1500.
Email: discover@alaska.net



COMMON ACORN BARNACLES & ROCKWEED, PHOTO BY KURT BYERS

A partnership for Alaska

This video and teacher guide were created by the Alaska Sea Grant College Program at the University of Alaska Fairbanks in partnership with the Center for Alaskan Coastal Studies in Homer, Alaska. Additional funding was provided by the Alaska Conservation Foundation. Video production is by Earthwise Media with Alaska Sea Grant. This guide was written by Marilyn Sigman, CACS. More of these videos and teacher guides are available from Alaska Sea Grant. Call 1-888-789-0090, or visit the Alaska Sea Grant Web site, address below.



www.uaf.edu/seagrant/



Center for Alaskan
Coastal Studies

www.akcoastalstudies.org/



Alaska
Conservation
Foundation
www.akcf.org/