Title: Intertidal Exploration

Adapted from the *Alaska Sea Week Curriculum, Vol. VI.*

Theme: Although life in the intertidal zone is challenging, a diverse range of invertebrates and algae have adapted to live there.

Objectives:

- Students will identify invertebrates found in intertidal zone.
- Students will understand the different challenges of living in the intertidal zones, from the splash and upper intertidal zones to the lower and subtidal intertidal zones.
- Students will understand the effects of oil on intertidal habitats.

Duration: 60-90 minutes

Age Range: 4th-12th Grade

Materials:

- Student notebooks
- Paper
- Pens or Pencils
- Posterboard or Whiteboard
- Markers or Dry-Erase Markers
- Intertidal Zones Worksheet
- Invertebrate ID Guides
- Small, clear containers

Background:

Intertidal Exploration is a great, hands-on way to explore the different components of an ecosystem and to learn about the challenges to life in the intertidal zones. Ideally, this activity is done as a field trip to a local intertidal zone, where students get to discover first-hand the diversity of organisms living in the intertidal zone. If a field trip is not feasible, Alaska ShoreZone (http://alaskafisheries.noaa.gov/shorezone) can be used for a virtual look at the nearest coastline in southcentral Alaska and MITZI virtual field trip (http://www.bigelow.org/mitzi/page_1.html) can be used as a virtual tour of the intertidal zones in Maine. Although the species are different, the categories and adaptations of organisms present in the Maine intertidal zone are commensurate to those existing along the rocky shores of Alaska. Hopefully, a virtual field trip through the Alaska SeaLife Center will be available soon.

After exploring the intertidal and learning about the different challenges and organisms in each zone of the intertidal, students can then discuss how an oil spill might affect intertidal organisms. Many intertidal invertebrates were heavily impacted by the *Exxon Valdez* Oil Spill because they were inundated with oil at every tidal cycle. Many of these creatures are planktonic filter feeders, so if oil is present, they will ingest it during the high tides, which can result in death, deformities, and illness. Oil spill clean ups can have significant effects on the intertidal zone, as clean-up workers step on barnacles and mussels and pressurized clean-up technologies sweep away intertidal life. At the time of the *Exxon Valdez* Oil Spill, pressurized hot water was sometimes used, which "cooked" intertidal organisms.

Preparation:

If you are participating in a physical field trip to the intertidal zone, check the tides and arrange your trip around a low tide (there are usually two per day in Alaska, approximately 12 hours apart). Ideally, set the trip for a lower than average low tide. Check with local non-profits, parks, or agencies that might be able to provide a volunteer or paid guide to help students find, identify, and understand organisms.

If time allows, familiarize yourself with the different types of animals you might see and some information about their predator and prey relationships. Being able to identify these relationships in an ecosystem will help students to understand food webs and how ecosystems are interdependent.

Prepare students for the field trip by reviewing how to visit an intertidal zone without disrupting the ecosystem. Basic tidepool stewardship includes: putting everything (living and non-living) back where you found it, keeping animals close to the ground if you pick them up, walking carefully and watching your step, cleaning up litter, being gentle if you touch organisms, and making sure that any rocks that were moved return to their original spot and orientation. Also, if students are going to be looking under rocks, it is best to put a limit on the size of rocks they can move (head size works well).

Introduction:

Pull apart the phrase "intertidal zone" so students understand that this phrase refers to the area that is underwater at high tides and exposed at low tides. Explain how animals that are normally covered by water at high tide are revealed at the lowest tides, and that most places in Alaska experience 2 high tides and 2 low tides a day. Ask students what sort of organisms they might expect to see in the intertidal zone.

Activities & Procedures:

On a physical field trip, provide students with ID guides to intertidal invertebrates and allow them to explore the intertidal zone as you travel as a group. When students find something interesting, bring the group together to view and identify the organism and discuss how it is linked to other biotic and abiotic factors in the intertidal zone. Fill a small, plastic container with saltwater and use it to carefully pass interesting organisms around the group for everyone to observe. Be sure to return the organisms to exactly where they came from.

Do a focused observation by having students spend some time (1-5 minutes) counting the biodiversity (number of different types of organisms) or abundance (total number of organisms) count in a small space. You can easily create square 1 foot by 1 foot quadrats from PVC to use for the abundance count. Even a loop of yarn about 3 feet in circumference will work just fine to focus student observations. Have each student pick a rock, tide-pool, and 1 foot by 1 foot area and quietly observe and count the organisms within the area. Then have students share their total counts and something interesting they observed.

On a virtual field trip, have students use MITZI virtual field trip to explore Maine intertidal zones and compare them to the animals found in Alaska using the intertidal guides. Use ShoreZone to look for zone indicators such as the black and orange band of blue-green algae and lichen in the splash zone, white band of barnacles in the upper intertidal, and blue band of mussels and golden-green band of rockweed (*Fucus spp*.) in the mid intertidal zone.

Upon return to the classroom from the virtual or physical field trip, have students pick one organism they observed to draw and research. Have students present their drawings to the class, along with key information about the animal such as what it eats, predators, unique adaptations, and what intertidal zone it inhabits. Have students place their organisms on a large sheet of poster board (or whiteboard) according to intertidal zonation. Be sure to include some examples of algae as well.

Introduce the concept of ecosystem disruption by first adding some litter to the ecosystem on the poster board. Ask students how this litter might affect different organisms in the ecosystem and how that will in turn affect other animals. What will happen if algae is covered by the litter? What if barnacles or mussels are covered? Remove some of the affected animals from the poster board.

Then, ask students what could be done to restore the ecosystem. Probe them to suggest things like picking up litter and reminding people not to litter with signs, posters, public service announcements, etc. Return the organisms to their spots in the intertidal zone.

If you would like, introduce the more complicated concept of an oil spill disrupting an ecosystem. Add drawings of oil sheen, mousse, and tar balls to the ecosystem. Discuss how these different products of an oil spill might affect different organisms. For example, remove some of the filter feeders that might ingest toxins from the oil

sheen. Cover some organisms with the thick mousse and smothers other with tar balls and remove them from the ecosystem. If appropriate for your class, discuss how even some clean-up techniques cause harm to intertidal organisms. Brainstorm ways that an ecosystem can be restored after an oil spill and/or how oil spills can be prevented; use these ideas to bring back parts of the ecosystem.

Wrap-up:

Discuss how organisms in the intertidal zones are connected to each other and how even a small disturbance can ripple throughout the ecosystem. Ask students to write in their notebook a list of ways to help protect intertidal organisms, explaining what animals benefit from the protection and how that affects the rest of the ecosystem. Choose and complete a stewardship project as a class that will benefit an intertidal ecosystem or other important local ecosystem (i.e. creating a guide for respectful tide pool exploration).

Evaluation:

Assess students during field trip for participation, adherence to stewardship guidelines, and safe and respectful behavior. Look at student drawings of intertidal organisms, and have students evaluate their own work to decide if they have drawn the details of their animal well enough that another student can identify the animal and placed it in the correct intertidal zone. The notebook reflections during the wrap-up serve as a formative assessment.

Intertidal Zonation Worksheet

Intertidal animals and plants have to be very hardy to survive exposure to air, fresh water (rain and snow), summertime warmth and dryness, wintertime freezing temperatures, and predators from both the land and the sea. On the outer coast, they have to be able to hang on in pounding surf. Even in the more protected bays and inlets, fierce storms and waves occasionally flare up. There are benefits, oo—the tide brings a fresh supply of rich food and nutrients twice a day. Each of the predators can reach them only at certain tidal stages—so there are periods of rest and recovery. Also, these tough intertidal conditions make it difficult for some species to compete for food and space. Each species of marine plant and animal has a particular tolerance to the hazards of being out of salt water. By looking at the beach in a section from its highest high water mark down to the water level of a low, low tide, you can quickly begin to see major differences in plant and animal populations.

The Highest Fringe
At the upper limits of the intertidal zone, the fewest life forms are evident. You may notice that the rocks appear black here. This is because they are covered by a black encrusting lichen or by a blue-green algae that makes the rocks treacherous and slippery when wet. In these upper reaches, too, may be found the common tiny periwinkle—a fat, ridged snail that sometimes seems to pepper the rocks.

The Middle Zone
As you move toward the water's edge at low tide, you will be aware of obvious color bands or patches on the beach. There may be bands of Fucus, the common brown rockweed, and of blue-black mussels (the intertidal and subtidal bivalves that attach themselves by tiny threads to rocks, pilings and other surfaces), and barnacles. Here too, you will begin to see limpets, amphipods, various sea stars, tiny black sea cucumbers, and other forms of life not in evidence at higher levels.

The Lowest Zone
Approaching the water's edge, you will not find some of the plants and animals evident at higher levels. In general, however, the lower you go in the intertidal zone, the greater the diversity of life forms. Here you will find sea urchins, a wide variety of large sea stars, perhaps juvenile King crabs, large white or vari-colored sea anemones, and the larger snails.

Answer these Questions:

1. What are five reasons why it is difficult for marine plants and animals to live in the intertidal zone?

   a

   b.

   c.

   d.

   e.

2. What are two life forms you can find at the upper limits of the intertidal zone?

   a.

   b.

3. What are six life forms you can see in the middle zone?

   a.

   b.

   c.

   d.

   e.

   f.

4. What are five marine life forms that you can see at the lowest zone?

   a.

   b.

   c.

   d.

   e.

5. Now think about the Exxon Valdez oil spill. What might be the effects of the oil on the beaches?

6. Which tidal zone(s) do you think would be impacted the most? And why?

7. Which invertebrates might be impacted?

8. Which vertebrates do you think might be impacted by oily beaches? (hint: think about the predator-prey relationships)

9. Make up a riddle or poem about your favorite intertidal creature and how they might be affected by an oil spill.

10. How can intertidal zones and organisms be protected from oil spills and pollution?

Intertidal Exploration Standards

Concepts of Life Science: Students develop an understanding of the concepts, models, theories, facts, evidence, systems, and processes of life science.

SC1
Students develop an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution.

The student demonstrates an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution by:

[3] SC1.1 sorting Alaskan plants and/or animals using physical characteristics (e.g., leaves, beaks)

[4] SC1.1 showing the relationship between physical characteristics of Alaskan organisms and the environment in which they live

[6] SC1.1 recognizing sexual and asexual reproduction

[3] SC1.2 describing how some traits (e.g., claws, teeth, camouflage) of living organisms have helped them survive as a species

[6] SC1.2 recognizing that species survive by adapting to changes in their environment

SC2
Students develop an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms.

The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by:

[3] SC2.1 sorting animals and plants into groups based on appearance and behaviors

[5] SC2.1 identifying and sorting animals into groups using basic external and internal features

[6] SC2.1 using a dichotomous key to classify animals and plants into groups using external or internal features

[3] SC2.2 observing and comparing external features of plants and of animals that may help them grow, survive, and reproduce

[4] SC2.2 describing the basic characteristics and requirements of living things

[5] SC2.2 explaining how external features and internal systems (i.e., respiratory, excretory, skeletal, circulatory, and digestive) of plants and animals may help them grow, survive, and reproduce

[6] SC2.2 identifying basic behaviors (e.g., migration, communication, hibernation) used by organisms to meet the requirements of life

SC3
Students develop an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy.

The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by:

[4] SC3.1 identifying examples of living and non-living things and the relationship between them(e.g., living things need water, herbivores need plants)

[3] SC3.2 organizing a simple food chain of familiar plants and animals

[4] SC3.2 identifying a simple food chain of familiar plants and animals, diagramming how energy flows through it; describing the effects of removing one link

[5] SC3.2 organizing a simple food chain of familiar plants and animals that traces the source of the energy back to sunlight