



Overview:

In this lesson, students examine the relationship between tectonics and ecology. More specifically, students examine how subsidence and uplift, volcanic eruptions, and tsunamis can affect the ecology of an area. Students explore how these types of changes to Earth's surface can affect subsistence users who depend on the land and sea for food.

Targeted Alaska Grade Level Expectations:

Science

[9] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[10-11] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating.

[10] SC3.2 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 exploring ecological relationships (e.g., competition, niche, feeding relationships, symbiosis).

[9-11] SD2.2 The student demonstrates an understanding of the forces that shape Earth by describing how the theory of plate tectonics explains the dynamic nature of its surface.

[9] SF1.1-SF3.1 The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by describing the scientific principles involved in a subsistence activity (e.g., hunting, fishing, gardening). (L)

Writing

[9-10] 4.2.3 The student writes for a variety of purposes and audiences by writing expressively when producing or responding to texts (e.g., poetry, journals, editorials, drama, reflective essays, and/or newsletters.)

Targeted Alaska Cultural Standards:

[D1] Culturally knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning. Students who meet this cultural standard are able to acquire in-depth cultural knowledge through active participation and meaningful interaction with Elders.

[E2] Culturally knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to understand the ecology and geography of the bioregion they inhabit.

Objectives:

The student will:

- observe and read examples of ecological effects of tectonics; and
- synthesize information from an Elder's presentation on local subsistence and tectonics.

Materials:

- Map of Alaska
- Digital camera (optional)
- STUDENT INFORMATION SHEET: “Tectonics and Ecology”
- STUDENT WORKSHEET: “Journal: Local Subsistence and Tectonic Events”
- VISUAL AID: “Effect of Subsidence”
- VISUAL AID: “Uplift in 1964”

Science Basics:

Earth’s surface is constantly changing. Dramatic tectonic events can affect living organisms. In the long term, balance in nature is restored as different species of plants and animals settle in the new habitats formed by uplift, subsidence, or volcanic eruptions. Middleton Island in Prince William Sound, known for its richness in biodiversity, formed as a result of uplift from a series of tectonic events. In the 1964 earthquake, a large area of tidelands was uplifted, initially killing many plants and animals that normally live underwater, but over time this new area of land became habitat for terrestrial flora and fauna. As a result of subsidence, ghost forests form when trees are inundated with seawater and die; new life grows in the new habitat around them. The STUDENT INFORMATION SHEET that accompanies this lesson describes accounts of how different species are affected by tectonic events and ultimately, how these changes can affect subsistence patterns.

Activity Preparation:

Make arrangements for an Elder to come in to speak on subsistence. Explain you would like your students to hear about local subsistence patterns (what local plants and animals are harvested, where and when they are harvested, what are their uses). Let the Elder know that you are also interested in how earthquakes, volcanoes, and/or tsunamis have affected the land and the plants or animals that live there and how subsistence activities were affected. If possible for the Elder and the class, plan the presentation at the beach where the Elder may point to relevant features directly. Plan for the Elder’s comfort with snacks and drinks. Consider making a small gift of appreciation. With the Elder’s permission, bring a digital camera to document information with photos.

Activity Procedure:

1. Explain students will see and read examples of connection among tectonic events, water level, and ecology. Later, students will listen to an Elder speak about local subsistence patterns and how events like earthquakes, volcanoes, and/or tsunamis may have affected subsistence.
2. Explain Earth’s surface is constantly changing. Dramatic tectonic events can affect living organisms. In the long term, these events are often positive as different species of plants and animals settle in the new habitat. NOTE: Use the map of Alaska to point out locations discussed in this lesson. Middleton Island in Prince William Sound formed as a result of uplift from a series of tectonic events. This island is known for its richness in biodiversity. In the 1964 earthquake, a large area of tidelands was uplifted, killing many plants and animals that normally live underwater, but creating new habitat for terrestrial species.
3. Display VISUAL AID: “Uplift in 1964.” Point out features discussed in the caption of each slide.
4. Explain subsidence affects ecology as well. The most visible form is the ghost forest. Display VISUAL AID: “Effects of Subsidence.” Ghost forests form when subsidence allows seawater into former freshwater areas.
5. Distribute STUDENT INFORMATION SHEET: “Tectonics and Ecology.” Explain this information sheet gives examples of ecological effects of tectonic events and connections to subsistence users in Alaska. Students read the article.

6. Ask students to consider how tectonics may affect the ecology of the local area. Brainstorm a list of local coastal plants and animals and how they are used for subsistence purposes.
7. Explain a local Elder will share information on local subsistence and how subsistence patterns may have changed as a result of tectonic events.
8. After the presentation, thank the Elder. Add more information to the list of local species and subsistence uses, if possible. If a digital camera was used, share the photos with the class to help debrief the content of the presentation.
9. Distribute STUDENT WORKSHEET: “Journal: Local Subsistence and Tectonic Events” for student completion.

Extension Ideas:

- Research a local plant or animal species.
- Use the digital photos to write a photojournal of the presentation.

Answers:

Answers will vary.

Lesson Information Sources:

- Black, L.T. (1981). Volcanism as a factor in human ecology: The Aleutian case. *Ethnohistory*, 28, 4, 313-340.
- Smelcer, J. E. (2006). *The day that cries forever: Stories of the destruction of Chenega during the 1964 Alaska Earthquake*. (p. 39). Anchorage, Alaska: Chenega Future.

Student Information Sheet



Along the Aleutian Arc, tectonic-related activity in the form of earthquakes, tsunamis, volcanoes, and landslides is a reality. These events can rapidly change Earth's surface and the habitats of plants and animals. The following account recorded by a Russian voyager illustrates how a volcanic eruption can dramatically affect an indigenous people's food source. This describes the formation of Bogoslof Island, as told by Georg Heinrich von Langsdorff in 1812, translated by Black.

In the year 1795 the islanders noticed a fog bank shrouding the vicinity of a rock [where they used to hunt sea lions]. The fog did not lift even in most clement weather and caused the inhabitants of Unalaska and the neighboring Umnak a lot of headaches, as it prevented them from obtaining one of their major food sources. In a couple of years, an Aleut, tired of waiting for the fog to lift, decided to attempt to reach the [sea lion] rock. He returned shortly in a state of great agitation with the news that what was supposed to be fog was "smoke" (steam). As it was believed that the spot was [now] inhabited by spirits, nobody went there until 1800, when the horizon cleared and the Aleuts observed much to their surprise not the rock they knew so well but a new mountain peak that flamed and smoked like a torch. (as cited in Black, 1981, p. 326)

The earthquake of 1964 also changed the vertical habitat for different species. Researchers Grantz, Plafker, and Kachadoorian reported a mass kill of red snappers in Prince William Sound. Red snappers live at depths of 30 to 200 feet. They stay close to rocky bottoms, ledges, and ridges. Possible causes of habitat change include local slope failures and tsunamis.

Henry Makarka of Cordova describes how uplift affected subsistence.

"The earthquake really changed the subsistence patterns of the area. Before the earthquakes, Cordova had been the clam capital of Alaska. But the violent shifting and shaking of the earth changed the depth of the bay by at least six feet, leaving miles and miles of clam beds high and dry-no longer covered by high tides.

That summer, tourists came in and walked around Main Street saying how beautiful the town was, but it sure did stink. That's what they said. Well, naturally it would. Within a couple of weeks, all those exposed waterfront clam beds were dying and rotting in the hot summer sun. You could walk around on the mudflats picking up tons of butter clams, cockles, horse clams; they were all dead on the surface or just beneath it. They were rotting, and when the west wind blew, it blew that stench of rotting clams right into town. It was hilarious at the time, but it was sad as far as the subsistence lifestyle. We used to say that when the tide was out, the table was set because all you had to do was walk around on the beaches and collect food to eat. But that was all gone. The razor clam beds throughout the whole area were killed off. In the time after that, there were hardly any clams at all. No butter clams, no cockles. Things were pretty scarce as far as subsistence goes. It took quite a while before people came back to their normal selves." (as cited in Smelcer, 2006, p.39)

