Unit Three  Logging, Fisheries and Wildlife

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Objectives:

To help students:

- Match pictures of trees and woodland shrubs with their descriptions (Activity 1).
- Inventory their own homes for wood products (Activity 1).
- Practice different harvest methods on a model forest (Activity 1).
- Sequence the growth and use of a tree from seed to wood product (Activity 1).
- Make a classroom mural of fish habitat needs in a stream and estuary (Activity 2).
- Develop a list of rules to protect fish habitat in a timber sale (Activity 2).
- Graph deer use of forests before and after clearcutting (Activity 3).
- Interpret data on bird use of old-growth forests (Activity 4).
- Read about the ways birds use old snags and place the events in a tree's cycle in sequence (Activity 4).
- Investigate and take field notes on fish, wildlife and vegetation on a logged over and old-growth forest (Activity 5).
- Write a poem or draw a picture about the field experiences (Activity 5).
- Describe the economics of logging (Activity 5 and 6).
- Mark local logging areas, proposed timber sales, and spawning streams on a map (Activity 6).
- Debate logging, fisheries and wildlife conflicts (Activity 6).
Unable resources for the benefit of all three to circulate to understand modern-day
effects Alaska's fisheries and wildlife and learning how to manage these vital renew-
until three: logging, fisheries and wildlife. Examining the way the timber industry

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TRAIL in TBO GOSS NATIONAL FOREST

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Forests are an integral part of our coastal and river habitat in southeastern, southcentral and Interior Alaska. Forests, fisheries and wildlife are all renewable resources, which means that with wise use, they will supply us with wood products, food, jobs, recreation and enjoyment forever. But as with any resource, harvest and management are both complex and controversial. The fall 1980 issue Alaska Fish Tales and Game Trails, published by the Alaska Department of Fish and Game, does an excellent job of analyzing these topics. (Kay Pearson at White Cliff Elementary in Ketchikan suggested many of the ideas for this unit.)

Activity 1
Logging Practices

Background:

One-third of Alaska is forested. Most of the Interior and southcentral forest is reserved for recreation, hunting, wildlife habitat, watershed protection and subsistence purposes. But much of the forest in Southeast Alaska and on Afognak Island is involved in timber harvesting that produces lumber and wood products for use here and abroad.

Vocabulary:

- renewable resource
- sustained yield
- allowable cut
- clearcutting
- single tree selection
- seed tree selection
- selective cutting
- skidder
- choker
- yarding
- thinning
- deciduous
- coniferous
Materials:

- samples of local tree species (branch tips)
- cake pan or cookie sheet with turned-up edges
- soil
- moss
- sticks or tips of tree branches
- construction paper
- scissors
- small saws or knives
- string
- worksheets:
  ...Do You Know Your Trees and Shrubs? (3A)
  ...Wood and Wood Products Inventory (3B)
  ...Log Those Trees (3C)
  ...From Seed to Lumber and Pulp (3D)

Procedure:

1. Ask students to name the local trees and shrubs. Put the list on the board. Pass out local tree and shrub samples and the worksheet Do You Know Your Trees and Shrubs? Explain the difference between deciduous (lose their leaves) and coniferous (evergreen) trees. But remember, tamarack is very unusual because it is considered a conifer even though it loses its needles every year. Have students match pictures with descriptions and circle species for which you have samples. Challenge students to find additional local species after school. Try to get a copy of Alaska Trees and Shrubs, by Viereck and Little, as a reference. Sometimes the Forest Service has copies (USFS, P.O. Box 1628, Juneau, Alaska 99802). Two versions of the book are in print: a condensed paper-


2. For homework, give students the worksheet Wood and Wood Products Inventory to report back on wood products that they use. Compile the results into a class list.

3. Have students relate their logging experiences. Explain that the class will be making a model forest to demonstrate logging techniques. Have students place soil in a cake pan or cookie sheet and add moss on top. Then add sticks or branch tips to make a "forest." Make a stream out of blue construction paper.

4. Use the worksheet Log Those Trees to introduce methods that the class can use to harvest their "forest." Go over the terms mentioned on the worksheet. (Answers: 1. seed tree selection, seed, seed; 2. clearcutting, cleared, cleared; 3. single tree selection; 4. 1, 3, only selected trees are cut; 5. cutting trees adjacent to the best trees so that the best trees will have more room to grow; 6. they can be continually replenished by growing up again from seeds; 8. circle the trees along the stream)

5. Have the class select one of
the three logging methods to demonstrate on their model forest. They will need knives or small handsaws to cut down the trees in lieu of power chain saws. The branches should be trimmed and the tops cut off. Then they can attach choker chains (string) and drag the logs either down to tidewater or up to a road for yarding (an area where the logs can be stacked). Loggers use a skidder (which looks something like a bulldozer) to drag several logs at once. Discuss the potential to cause soil erosion as the moss and topsoil is torn up by the skidding operation. Be sure to leave some trees along the stream, and don’t do any skidding across the stream—to reduce erosion and protect the fish in the stream. (See the next activity for more explanation.) On very steep slopes, loggers will sometimes use balloons or helicopters to help with the harvest, so that skidders do not constantly run up and down the slope, causing soil erosion that is usually irreparable.

6. So now the class either has the logs to tidewater or lying beside a logging road. What happens next? Use the worksheet From Seed to Lumber and Pulp to discuss the lumbering process. (Answers: Tree seeds, tree seedling, full-grown tree, timber, trim branches and top, attach choker chain, skidder hauls to road or tidewater, logging truck or log boom, lumber and pulp mill, lumber, off to Japan, scrap lumber, paper mill, pulp, stores, your house, your summer job planting trees—these last, from lumber on, are quite variable!)

Additional Activities:

1. Science, Art. Have students make a leaf/needle collection of the local tree and shrub species, complete with drawings of the full-size trees and identifying marks. Students can add forest plants to their inventory, too. Use Hulten's Flora of Alaska for identification, or Viereck and Little's Alaska Trees and Shrubs.

2. Math. Have students figure how many trees were used to make all the wood and wood products in their homes. Obtain information on the number of board feet in an average tree from a local forester. (A board foot is 1' x 1' x 1".) If students burn firewood, have them figure the number of trees required to heat their house every year. (One cord equals a 4' x 4' x 8' stack of wood.)

3. History, Social Studies. Read portions of Handloggers by W.H. Jackson and discuss old-time logging practices. Invite a logger or forester to come to your class and discuss present-day logging methods, and to answer your questions about logging practices in your area.

4. Science. Take a beach or riverbank walk, trying to identify species of driftwood and guess where it originated. Driftwood along the northern Alaska coast generally comes from the Mackenzie River Delta. Western Alaska's driftwood comes from the Yukon River.
Activity 2
Fish Streams and Timber Sales

Background:

Proper use of Alaska's timber and fisheries, both renewable resources if used wisely, is a question fraught with controversy, especially in Southeast Alaska. Fisheries biologists believe that the two major factors that have reduced Southeast salmonid stocks are overfishing and loss of habitat.

"Though overfishing is a complex management problem, it is compounded by the loss of habitat, which either delays or prevents the recovery of individual salmonid populations. At present, timber harvest and associated activities are the primary commercial uses of forest lands in Southeast Alaska, and consequently, have the greatest potential for altering habitat."

---from "Chain Logs, Food Chains and Fish Streams" by Elliott, Koeki and Meehan in Alaskan Fish Tales and Game Trails, Fall 1980

Information for this activity was adapted from the above-mentioned article and the Forest Service pamphlet, Logging and Fish Habitat.

Vocabulary:

- pool
- riffle
- sedimentation
- turbidity
- nutrients
- microorganisms
- microbes
- debris
- estuary

Materials:

- large sheet of butcher paper or chalkboard
- felt-tip markers or chalk
- worksheet:
  ...As a Fisheries Biologist (3E)

1. Make a classroom mural (see illustration) of a stream and downstream estuary on either a large sheet of butcher paper or on the blackboard— as the basis for discussion of fish habitat needs. Review the meaning of estuary (a highly productive wetland where fresh and salt water mix as a river or stream meets the sea. For more information on wetlands and fisheries, check Alaska Sea Week Curriculum Series, volumes V and VI). Ask students:

- What are the three basic requirements of all fish? (Food, cover and water quality, including temperature, oxygen and nutrients in both the stream and downstream estuary. Cover for fish includes instream and overhanging logs that can be used for hiding from predators, as well as shrubs and trees that provide shadows for hiding. Add this information to your drawing.)
What do the fish in the stream eat? (Insects, both land and aquatic varieties. Add these to your drawing. Some types of insects live in pools and others live in riffles.)

What do the insects eat? (The microorganisms on needles, twigs, and leaves that fall into the stream or are adjacent to the stream. The microorganisms on this dead vegetation are like "peanut butter on a cracker" for the insects; i.e., the microbes supply the protein and nutrients for the insects.)

Where does this instream vegetation that the microbes like so much come from? (From shrubs and trees along the stream.)

Why else are trees and shrubs along the stream important? [They provide cover (protection from enemies) in their shadows and shade, so that the stream temperature remains cool in the summer. And trees help to insulate the stream in the winter, preventing freeze-up. Dead trees that fall into the stream or across streams also provide cover and shade, as well as sometimes helping to form pools, which are good places for fish to rest.]

How do salmon use the stream? (They need clean gravels, oxygen, and cool temperatures for spawning and for rearing their young. Pink and chum smolt migrate to both estuaries and the sea during their first spring, but king, coho, and sockeye salmon, rainbow and cutthroat trout, and sea-run Dolly Varden char spend one to two years in streams and lakes before heading to the sea.)

Where do nutrients come from and where do they go? (Many nutrients come from streamside vegetation, which decays and falls in the water where it is fed on by insects. Nutrients also come from the bodies of spawned-out salmon. A few minerals and nutrients come from rocks and soil. All the leftover nutrients go downstream to the estuary, where they feed zooplankton, which in turn feed many varieties of coastal fish and shellfish.)

How does the stream maintain high oxygen levels? (By staying cool, for cool water holds more oxygen; by having riffles, which mix oxygen with stream water; and by remaining unpolluted. For example, if too much organic material, such as logging debris, remains in a stream, the animals helping it decay increase in numbers. Since these all require oxygen, an oxygen deficit is created.)

What does increased sediment mean to the fish in a stream? (It causes fish eggs to be covered up so they don't get any oxygen and they die. It causes the instream vegetation to be covered up so microbes and insects don't have a place to feed. And with increased turbidity (sediment in the water), fish have trouble seeing their food. Sediment also fills in the pools, reducing the number of resting places.)
Fish Habitat Needs

Salmon Life Cycle

- eggs
- alevin
- fry
- smolt
- adult

All Fish Need:
- insects in pools and riffles
- dead vegetation with microbes growing on it
- spawning area
- sedimentation
- logging debris
- erosion
- tree bark

Food
- water quality
- shelter

Estuary

Salmon eggs

Salmon alevins

Salmon smolt

Salmon fry
How does sediment get into a stream as a result of logging? (From erosion caused by the loss of the trees, shrubs and ground cover that hold the soil in place. Roads, skidding logs, logging on steep slopes and not leaving a streamside barrier to help hold the soil all contribute to increased erosion and the resulting sedimentation of the stream.)

What is the effect of log dumping, storage and erosion on estuaries? (Increased sediments cover up bottom-dwelling organisms and reduce light levels in the water, so less plankton can grow, which in turn means less food for fish. Studies have shown that crab reproduction is reduced in areas where bark covers the sea floor. Also, some of the natural chemicals found in tree bark are toxic to young shrimp, Dungeness crab and pink salmon.)

For further information, consult "Chain Logs, Food Chains, and Fish Streams" by Elliot, Koski, and Meehan in Alaska Fish Tales and Game Trails, Fall 1980.

1. Fall and yard timber away from streams when logging close to streambanks.

2. Leave a fringe of wind-firm timber along streams for stream protection.

3. Keep debris out of streams. If some does get into streams, remove it immediately.

4. Avoid skidding logs in or across streambeds.

5. Do not run equipment in the streams.

6. Use proper stream-crossing bridges for equipment. Orient road-stream crossing at right angles to minimize erosion possibilities.

7. Do not yard across or out of V-notches if logs cannot be fully suspended above ground.

8. Properly engineer road grades, alignment, cut-slopes, waste areas, and culvert and cross-ditch locations. Install and maintain culverts properly.

9. Restore the original level of the streambed when removing all temporary culverts.

10. Revegetate any disturbed soil.

11. Avoid logging altogether on extremely steep slopes (helicopter and balloon logging can be used on moderately steep slopes).
Activity 3
The Deer and Logging Dilemma

Background:

In the Lower 48, biologists have been claiming that clearcutting improves habitat for deer. But in Alaska, joint studies by the Alaska Department of Fish and Game and the U.S. Forest Service show that clearcutting drastically reduces deer use.

The problem is twofold: 1) Clearcuts (0-25 years) have ample deer forage, but they fill with snow in winter and are thus unusable; 2) second growth (25-150 years) with its even-age growth doesn't allow light on the forest floor, so deer forage can't grow. In contrast, old-growth (climax) forests (200 years) are composed of trees of different ages and sizes. The upper limbs intercept the snow, and yet there are enough holes in the forest canopy so that light can get through to grow ample deer forage.

As a result of this research, biologists in the Lower 48 are reanalyzing their data. It appears that they were actually looking at second growth, even-age forests when they were saying "old growth" was poor deer habitat. According to accounts of early descriptions of virgin forests on the North American continent, deer were abundant. Much of the timber harvest in Alaska, particularly in Southeast, is in this old-growth forest. If recutting continually occurs at 100 years as is proposed, this old-growth habitat will be lost for deer as well as for other animals.

(Additional background information can be found in two articles in Alaska Fish Tales and Game Trails, "Deer Logging Relationships in Southeast Alaska" by Schoen and Wallmo, July/August 1978, and "Deer, Forestry, Logging Habitat" by Lentfer, Schoen, Matthews and Kirchhoff, Fall 1980. Additionally, in the Alaska Department of Fish and Game's Wildlife Information Leaflet #5, Sept. 1978, "Deer and Logging: A Clearcut Dilemma.")

Vocabulary:

- succession
- climax forest
- old-growth forest
- rotation
- stand
- pellet-groups
- diversity
- canopy
- understory

Materials:

- worksheet:
  ...Graphing Deer Use of Clearcuts (3F)

Procedure:

1. Introduce or review the term "succession." (All plant communities are constantly grow-
ing and changing until they reach their climax stage of vegetation. After a burn or as a glacier recedes and leaves bare ground, some species of plants begin to grow. These plants add enough organic matter to the soil so that other species of plants can grow. Then shrubs take over, and eventually trees dominate. Explain that biologists have become concerned about deer use of clearcuts. Ask students:

How would you go about figuring out how many deer are in a certain area? (Take aerial counts, though this might be hard in thickly forested areas. Check hunting success records, though this might depend on weather and numbers of hunters. Count the number of pellet groups (piles of fecal pellets) left by deer. The latter is what biologists did in Southeast Alaska. They set up 1x10-meter belt plots across the stand of timber and counted the pellet groups within each plot.)

2. Distribute the worksheet Graphing Deer Use of Clearcuts. These figures are from "Response of Deer to Secondary Forest Succession in Southeast Alaska" by Wallmo and Schoen in Forest Science, Vol. 26, No. 3, 1980, pp. 448-462. Explain that the figures would be similar for forests in Prince William Sound and on Afognak Island.

(Assignments: 1. (illus.); 2a. 300 year uneven-aged stand; 2b. 300 year uneven-aged stand; 2a. 3; 2b. 0; 2c. 2; 2d. 1667; 2e. 1667; 2f. 99; 2b. 499; 2c. 169; 2d. 1206; 4e. (illus.); 4f. (illus.); 5. 250-300 years; 6. populations will decline)

Additional Activities:

1. Science, Social Studies. Invite a wildlife biologist to speak and show slides to your class about deer and other wildlife uses of old-growth forests. Bald eagles, mountain goats, moose, marten, brown bear, Canada geese and a number of other birds also use old-growth forests. Begin thinking about jobs in the timber industry versus wildlife values (See Activity 6 in this unit).

2. Math. Obtain figures from the U.S. Forest Service on the current Tongass National Forest acreage, its yearly allowable cut, and the acreage that is classified as old-growth. Then figure the current percentage of old-growth forest and the percentage that will remain in 10, 20, 30, 40, 50 and 100 years. The high volume old-growth timber, which occupies a small proportion of the total forest, is usually the best winter deer habitat. However, it is also the preferred type of logging area, and is cut in much higher proportion than it occurs.
Activity 4
Bird Use of Old-Growth Forests

Background:

In recent years, interest has grown all over the country in non-game wildlife species. Bird-watching, for example, has become a multi-million dollar business, with people buying bird books, binoculars, cameras, outdoor clothing and other equipment, as well as driving and flying endless miles in pursuit of elusive birds. The Alaska Department of Fish and Game now has a non-game program, and other agencies are also funding research and educational programs. Hunters and non-hunters alike enjoy bird songs and sightings. Non-game birds and other wildlife are an important part of our total environment.

Vocabulary

- non-game
- cavity nesters
- snag
- riparian
- edge effect

Materials:

- pencils
- glue
- paper
- bird field guides
- worksheets:
  * Birds in the Old-Growth Forest (3G)
  * Save that Snag! (3H)

Procedure:

1. Introduce the concept of non-game wildlife species. Distribute the worksheet Birds in the Old-Growth Forest. (Answers: 1. Greater: orange-crowned warbler, dark-eyed junco, Steller’s jay, fox sparrow; Smaller: chestnut-backed chickadee, golden-crowned kinglet, western flycatcher, hermit thrush, varied thrush 2. winter wren; orange-crowned warbler; golden-crowned kinglet 3. Townsend’s warbler, golden-crowned kinglet 4. mid-successional. 5. not necessarily. This study was only done once in one specific area. A study done on another forest with a different terrain and climate and different types of trees and shrubs would show different results. (Studies in some areas have shown greatest diversity in old-growth forest and in others, like this one, in a particular stage.) 6. There might be fewer kinds of birds because there is less variety of plants for them to eat or nest in. 7. (illus.); 8. in tree cavities; 9a. streamside; 9b. drawing should show trees left along stream and several small clearcuts to maximize the "edge" effect)

3. Discuss the idea that some bird species have become extinct because of habitat loss. For example, the American ivory-billed woodpecker is probably extinct because it needed old-growth forests to survive. The passenger pigeon is another bird that became extinct--partly due to loss of its old-growth forest habitat, partly from overhunting. R.M. DeGraaf notes, in the article mentioned earlier, that 85 of the 800 U.S. bird species are cavity nesters. These birds play an important role in the forest as pest-control agents. Most are insect eaters.

Activity 5
Logging Field Trip

Throughout this unit, students have been learning about different aspects of logging and its effects on fish and wildlife. A well-planned field trip can strengthen what they've been learning and give them a chance to see logging in action.

Materials:

- paper
- pencils
- tree borer
- logging operation or logged-over area
- lined paper
- measuring tape
- small plastic bags
- string
- field guides to trees, birds, animal tracks, insects
- thermometers
- old-growth forest
- resource people - logger, forester, fisheries and/or wildlife biologist
- Fish Habitat Guidelines (from Activity 2) for each student
- worksheet:
  ...Comparing Stumps and Trees (31)
Procedure:

1. Arrange for students to visit a logging operation and an old-growth forest. Plan to talk to one of the loggers on site. Invite a forester, wildlife and/or fisheries biologist to go with the class.

2. Have the class make field notebooks by cutting lined paper in fourths and stapling it together. Attach a pencil with a string and place in small plastic bags in case of rain. Discuss with students the importance of taking accurate notes on what they see. If they do not know what something is, have them draw pictures. Tell them that after the field trip, they will be comparing the logged-over area to the old-growth forest; so to take good notes and be sure to write down the date, time and location.

3. Have a logger at the logging operation explain what's happening. Ask the logger about the economics of logging and about the dangers of being a logger. What safety practices do they use?

Look at a stream within the logged area. Watch for signs of erosion and/or sedimentation. Does this logging operation follow the fish habitat guidelines your class developed in Activity 2? Have students check each one. Then look for fish in the stream.

Find a stump and figure out the age of the tree. Measure its diameter and height above the ground. Check for signs of decay. Squeeze a little bit of rotten wood on the stump or from an older log on the ground and see how much water it holds.

Listen and watch for birds. Your class might want to try setting up a bird transect. Measure off 100 meters and stop every 20 meters and listen and watch for birds, as described in worksheet 3G.

Look for animal signs such as deer pellets. If the clearcut is new, try to figure out whether they were dropped before or after it was made. Count the number of pellet groups in 1x10-meter plots, as in Activity 3.

Watch for tracks, too. Measure the distances between tracks and note the shape and pattern.

Measure and record the soil temperature, air temperature and water temperature at different points in the logged and unlogged portions of the forest.

Investigate a square foot of soil. See what insects students find, and then be sure they replace the soil just as they found it.

Have students identify trees and other plants. Estimate tree heights. One quick way is to have a person of known height stand next to the tree. Stand a distance away and hold a pencil or short stick at arm's length. Sight across the top of the stick to the student's head. Slide your thumb up or down on the stick until you sight on the top of the thumb to his feet. Keep your thumb at this position. Then begin raising
the stick up the tree and count the number of "person heights" it takes to reach the top. The height of the tree is this number times the height of the person. Many other ways to compute tree heights and to take other tree measurements are included in Outdoor Activities for Environmental Studies by Clifford E. Knapp (see bibliography).

If foresters are handy, have them show you how to "cruise" timber (measure the trees to find out how much lumber the company can expect to harvest from the sale). Melissa Hadley's Measuring the Forest explains this process in detail.

Also, take some quiet time to just listen, draw a picture, or write a poem, especially if it is a nice day.

4. Go to the old-growth forest and do similar studies. Here you may have to use a tree borer to estimate tree age, though the trees may be so big it would be of little use!

5. If you have time, also stop at an area that was clearcut quite awhile ago. It's important to see these older (40-100 years) second-growth stands. These are where the problems are for foraging deer in particular.

6. Back in the classroom, have students transcribe their notes onto the worksheet Comparing Stumps and Trees. Compile the class data on the board. Discuss difficulties encountered in taking field notes. Then have students write up the results of their field investigations.

Additional Activities:

1. Art, Science. Make dioramas of the logging operation and logged over and old-growth forest.

2. Social Studies, Art. Visit a logging mill. Ask questions about economics, jobs, safety, sustained yield, allowable cut, silviculture (tree farming) and environmental protection. Afterwards, have students diagram the route a log takes as it goes through the mill, and what happens afterwards.
Activity 6
Logging, Fisheries and Wildlife Debate

Background:

In this unit, the class has been gathering information on wildlife, fisheries and logging concerns. This activity gives students a chance to pull all this information together both for an in-depth analysis of the issues and for practice with critical thinking skills. Perhaps these same students will contribute to solutions.

A key to resource-issue solutions are the agencies responsible for management. The U.S. Forest Service is a multiple-use agency. Their lands can be used for timber harvesting, mining, hunting, fishing, wildlife viewing and recreation, though not all at the same time! The Bureau of Land Management (BLM) has similar responsibilities for the interior lands of Alaska. The National Park Service manages its lands primarily for wildlife viewing, natural history interpretation, and recreation. Sport hunting is allowed in preserves managed by the Park Service, but not in parks, where only subsistence hunting is allowed.

The U.S. Fish and Wildlife Service manages national wildlife refuges. Their prime interest is fish and wildlife habitat protection. Mining and oil drilling are sometimes allowed, as on the Kenai Moose Range, but fish and wildlife protection comes first. The U.S. Fish and Wildlife Service manages migratory birds such as geese and ducks, and also sets hunting seasons and bag limits.

The Alaska Department of Fish and Game manages all other fish and wildlife. The boards of Fish and Game set the regulations, and the department carries them out. Fish and Game personnel research and study various wildlife species and habitats, and also make recommendations to the Fish and Game boards. Fish and wildlife protection officers in the Alaska Department of Public Safety arrests people who don't obey the regulations, and they also follow cases into the courtroom.

The National Marine Fisheries Service handles fisheries management concerns that are farther than three miles from the coast. Offshore regulations are suggested by the International Halibut Commission and the North Pacific Fisheries Management Council. State forestry concerns are handled by the Division of Forestry within the Alaska Natural Resources Department. Native corporations now figure prominently in resource decisions because of their considerable land holdings and capital, received in the Alaska Native Claims Settlement Act of 1971.
Materials:
- felt-tip markers
- local area maps
- fisheries and wildlife biologists
- logging industry representatives
- agency and Native corporation representatives

Procedure:

1. Have students contact state and federal agencies and Native corporation representatives to find out local land ownership patterns, as well as past and future plans for timber sales and logging operations. Color-code and put this information on local area maps. Then talk to the Alaska Department of Fish and Game and knowledgeable local residents about where spawning streams and important deer, bird and other wildlife habitat are located. Mark this information on the map in another color.

2. Discuss the role of each agency in resource management.

3. Invite fisheries and wildlife biologists and representatives of fishing organizations, logging companies, the U.S. Forest Service and the local Native corporation to have a panel discussion or debate. Sometimes, because of scheduling difficulties or reluctance of people to meet with those holding opposing viewpoints, your class might have one person visit one day, and another the next. Sometimes it is more exciting to have just two people debating, but other times a panel is more interesting. Students should prepare questions ahead of time and write down additional ones during the presentations. Remind them to listen carefully to the different viewpoints.

4. Afterwards, have students hold their own debate. This can be done even if you are unable to get speakers. Assign students to research different points of view. Just for fun, you might want to have students switch and defend a different point of view. Or students might submit written summaries of the different viewpoints. Discuss the complexity of issues. Sometimes compromises work and other times people just have to decide whether they want fish to eat or lumber for a new house. Can your students propose solutions? Discuss who would be the best people to implement their suggestions. Have students write or talk to them about their ideas.
Unit Four
Oil and Oil Development

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Objectives:

To help students:

* Read about how oil originates and where it goes (Activity 1).

* Make an Alaska Oil Timeline (Activity 1).

* Inventory oil and oil products used at home and at school (Activity 2).

* Photograph oil uses and misuses around the community (Activity 2).

* Design and implement an education program on oil uses and conservation (Activity 2).

* Construct a graph to show sources of ocean oil pollution (Activity 3).

* Read about effects of oil spills on fish and wildlife (Activity 3).

* Practice cleaning up an oil spill (Activity 3).

* Figure the mathematics of the offshore leasing schedule (Activity 4).

* Produce an imaginary TV special about the effects of offshore drilling (Activity 4).
which has had such enormous impacts, for better and for worse, on Alaska's landscape.

Wright at a wellhead, and a tanker at Valdez—converting pictures of the oil industry.

The rig on the North Slope, the pipeline and camp complex at Prudhoe Bay. Drawings by

UNIT FOUR: Oil and Oil Development. Oilwaste from Upper Jet are an offshore drill

1971.
With the push for energy independence, oil and gas development in the nation's offshore waters has accelerated. Alaska is at the center of the controversy, with as much coastline as the entire rest of the United States, and a huge chunk of the outer continental shelf where most of the oil is located.

Activity 1
Finding That Oil

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Most Alaskans welcome the jobs and money our oil brings in. And considering the nation's pressing need for energy, there's probably no way we could stop oil development even if we wanted to. But at the same time there is a nagging worry over what might happen in the process, and whether our wilderness and wildlife and special lifestyle will still be around when the oil runs out.

So the trick is to be sure that the things that make Alaska such a good place to live are preserved. And that if changes are made, they are changes for the better. Can we do this? How?
WHAT WE GET

1. MONEY!! Billions and billions of dollars in taxes and a share of the wealth—$3.6 billion in 1981 alone. That's enough to pay most of the cost of state government; build schools, roads, power projects and such; provide low-cost loans for houses, boats, businesses and college educations, and still put money away for the future. (All this with no state income taxes from us.)

2. Jobs—not just with the oil companies, but all kinds of spin-off and support jobs made possible by those oil dollars. State officials say that at least one-third of the work force in Alaska today is dependent upon the oil industry.

WHAT WE GIVE

1. OIL!! Billions and billions of barrels of it. Alaska supplies the United States with about 18 percent of the oil it uses each day. And that's only the beginning. We still have about 30 percent of the nation's proven oil supply that hasn't been touched, and perhaps 50 percent of its oil reserves still to be found. (But once our oil is gone, it's gone forever.)

2. The very big risk that oil spills and industrial activity might damage Alaska's fisheries, wildlife and marine mammals, and our unspoiled waters and wilderness areas—and with this, even our way of life.

The above article is excerpted and adapted from Alaska Tidelines (see credit at beginning).

Vocabulary:

- pterodactyl
- nonrenewable
- petroleum
- reservoir
- shale
- porous
- sedimentary
- seismograph
- casing
- refinery
- royalty

Materials:

- pencil
- paper
- scissors
- glue or tape
- ruler
- worksheets:
  ...From Pterodactyls to Petroleum: Predictions (4A)
  ...Where Does the Oil Go? (4B)
  ...The Alaska Oil Timeline (4C)
  ...Alaskan Oil Finance (4D)
  ...Petro Puzzler (4E)

Procedure:

1. Ask students what the effect of oil's discovery in Alaska has had both on the local community and on the rest of the state. Mention what we get and what we give. How has the oil affected every student in the class?

2. Distribute the worksheet From Pterodactyls to Petroleum: Predictions. (Answers: 1. true; 2. true; 3. false; 4.
true; 5. false; 6. true; 7. false; 8. true; 9. false.) Remind students that oil originates primarily from decayed plants, as well as from animals such as pterodactyl. Mention that oil is a nonrenewable resource—once used up, it’s gone forever, or at least until more plants and animals decay. And each quart of oil took thousands and thousands of years to form. It really is black gold!

3. Distribute the worksheet
Where Does the Oil Go?
(Answers: 1. pumped back into the ground; 2. piped to Anchorage and nearby communities for fuel; 3. down the pipeline to Valdez and onto tankers for shipment outside; 4. to refineries on the Kenai Peninsula; 5. chemicals made from oil and gas; 6. hydrogen and carbon; 7a. fuel gas; 7b. gasoline; 7c. jet fuel; 7d. heating oil; 7e. lubricating oil; 8a. gasoline; 8b. lubricating oil; 8c. jet fuel.)

4. For the next worksheet, The Alaska Oil Timeline, students will need rulers, scissors, paper, and glue or tape. After they have set the events in proper order, have them research recent developments and write a paragraph together to add to the right end of the timeline.

5. Hand out the worksheet
Alaskan Oil Finance. (Answers: Where it comes from; 1. 90 percent; 2. $400 million, $3.6 billion; Where it Goes: 1. $320 million; 2. 26 percent; 3a. education and general government; 3b. natural resource management)

6. Finally, try the Petro Puzzler! (Solution below:)

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ROCK \H \ALF INTO YEAR
SC RED \NE KEN CRUDE
EE OCE
CLAIM ASO
MARIGEE
SKIS AREA
HEAT SAND
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Activity 2
Oil in Your Community

Background:
Oil and its products are an integral part of our society, from transportation to plastics. Alaska is at the "end of the road." Little recycling occurs here, and as a result, our dumps are filled with used oil products—many that are harmful to the environment.

Materials:
- paper
- pencils
- camera and film
- magazines
- scissors
- felt-tip markers

Procedure:
1. Discuss the role of oil in your community. Ask students:
   - How many products do we use in school that are made from oil? (List plastics, styrofoam, movie films, records, tapes, synthetic fabrics, as well as gas and oil.)
   - Assign the class to inventory their homes for products made from oil and to research the current prices of gasoline, jet fuel, kerosene, heating oil, lubricating oil, propane.

2. Pass out magazines. Have students cut out pictures of oil products for a bulletin board. Use felt-tip markers for picture captions.

3. Have students make a class list of all the oil and oil-product messes around your community, such as old oil drums, oil storage tanks, oil pipelines, gasoline and kerosene spills at the gas pumps, discarded oil from boat motors, crankcase oil from vehicles, and oil dumped by boats or ships.

Discuss ways oil and oil products could be reused or disposed of properly. Add this information to your bulletin board. Do not forget that plastics can also be a danger to animals that eat them. Sometimes they choke on them or retain the stuff in their stomachs permanently, taking up room that is better used for food.

A high percentage of Alaska seabirds have been found with plastics in their stomachs. Those that eat fish eggs are particularly susceptible, as they evidently mistake as food the round particles that styrofoam breaks down into. Other birds and wildlife end up with plastics (such as the filament fish nets) wrapped around their necks, cutting off their ability to breathe, eat and flee from predators.
4. Take a field trip around your community to look for oil products and messes. Take notes and photograph your findings. Even the simplest camera will work for this exercise. Make sure students get close enough to their target and hold their breath, letting it out slowly as they snap the picture. Use prints to make posters, or shoot slides for a slide show.

5. What can your class do to help? Remember, oil is a nonrenewable resource. Once used up, we will not have any more. Discuss conservation. Ask the class for suggestions like the following:

Reuse plastic bags; use cups that can be washed rather than styrofoam cups; be careful not to spill oil; reuse old oil for wood stove fire starter (mixed with sawdust but be very careful) or for oiling tools and shotguns; limit boat or car or snow-go trips to only necessary ones.

Note that many communities have specific oil-dump sites where oil is placed in storage tanks and stored for later use. Sometimes leftover oil can be used for heating fuel.

Perhaps your class can plan an education program on local oil uses and misuses. Make up cartoons and posters or a slide show and present your findings and suggestions to other classes and the community.

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Activity 3

Oil Spill

Background:

With increasing oil shortages and heightened environmental awareness, tremendous efforts are being made to prevent oil spills. Yet they still occur. In 1975, the U.S. National Academy of Sciences estimated that 6,100,000 metric tons of petroleum products enter the oceans each year. More recent estimates are still close to this amount. A major oil spill can take a devastating toll on wildlife. Sea birds are attracted to oil slicks and will try to dive and feed in them, hopelessly oiling their feathers. When oil gets in the fur of seals, sea lions and sea otters, it means a loss of insulation. In the great baleen whales, oil clogs the hairs that filter plankton out of the water, thus impairing their feeding. Eggs and young of many species of fish and shellfish are harmed by extremely small concentrations of oil (as low as 1 to 10 parts per billion!). Larger—but-still-small concentrations (10 to 100 parts per billion) can cause reduced feeding or reproduction in adult fish. And as the spill moves onshore, intertidal organisms, as well as shore birds, are affected.
Large spills are the most spectacular, but it is the day-to-day operations of oil tankers and daily life in coastal and river communities that actually do the most damage.

Materials:

- pencils
- protractor
- pan of water for each group of students
- small oil sample
- bird feathers
- pondweed or seaweed
- eyedroppers
- sand
- paper towels
- detergent
- string
- oil absorbent material
- worksheets:
  ... Ocean Oil Pollution (4F)
  ... Oil Spills and Clean-up (4G)

Procedure:

1. Distribute the worksheet Ocean Oil Pollution, adapted from an oil spill packet developed by the Ohio Sea Grant Program. Students will need pencils and protractors. (Answers: degrees in column 3 from top to bottom: 36°, 79°, 11°, 36°, 112°, 47°, 4°, 36°—this totals 361° if students round off the degrees; 1a. tanker accidents; 1b. 3 percent; 2a. coastal facilities; 2b. 13 percent; 3a. tanker operations; 3b. 22 percent; 4. well blowing up, drilling rig sinking, transferring oil from the rig to ship or pipeline; 5a. runoff from roads or trails, people dumping oil, seepage from dumps, vehicle going in water, boat engine use, especially if it's not working properly, etc.; 5b. rain or snow falling on the road and then dripping into the water; 6a. answers will vary, but one potential increase is from offshore drilling, due to the greatly accelerated leasing and drilling program as well and to the difficulty of drilling under northern storm and ice conditions; 6b. answers will vary, but decreases depend a lot on all of us, and also on any changes in oil production and transportation.)

2. Now have the class try to mop up their own spills. Divide the class into teams and pass out the worksheet Oil Spills and Clean-up, adapted from the Ohio Sea Grant "Oil Spill!" activity packet with the help of Jennifer Allison Keim of the Scammon Bay School.

Have students begin reading and answering the first four questions while you give each group a bowl or pan of water. (The containers should be ones you do not mind getting a little oil on!) Set out a small container of oil. One film canister full is enough for the whole class. Use a heavy-duty oil such as old crankcase oil, if possible, but any type will do. Also put out a few bird feathers, pondweed or seaweed, eyedroppers, string, scissors, sand, paper towels, dishwashing detergent. Obtain oil-absorbent material that is used for mopping up "real" oil spills from hardware stores or marine supply catalogs.
(Answers: 1. a big tanker crashing on the rocks near a salmon stream during spawning season; 2. and 3. diesel and heating oils are the most poisonous, while heavy crude and fuel oils are worse for smothering animals; 4. No. Rocky shores clean themselves the most easily, by wave action. Bays, estuaries and marshes have few waves and the oil stays much longer.; 5. Yes; 6. answers will vary; 7a. answers will vary; 7b. bottom organisms will sicken or be smothered; 7c. No. too many bad effects on bottom organisms; 8. fairly well; 9. by breaking up the oil droplets; 10. tremendously; 11a. it coats the plant; 11b. It would keep them from getting enough light to produce food. Remind students, too, that the phytoplankton (tiny floating plants) produce a large percentage of the world's oxygen, besides being the basis of the ocean's food web; 12a. it sinks; 12b. it would lose its insulation and ability to float, and it might accidentally swallow some oil and poison itself; 13. wind; fog; ice; extreme cold temperatures; storms and waves (up to 100 feet or more in the Bering Sea and Gulf of Alaska); and spills occurring far away from population centers where the spills would be more likely to be spotted when they first occur, and therefore more easily cleaned up.)

3. As a finale, read the following article to your students about some hopes for the future.

OIL BUGS AND OIL BIRDS

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Most living creatures give oil a wide berth. But there are tiny bugs that lap it up and lick their chops for more. They are a kind of bacteria called petrophiles. (It's a good name, since petro is short for "petroleum," of course, and "philes" comes from the Greek philos, meaning "fond of.")

Petrophiles can chew up petroleum products anywhere—even the asphalt used in making blacktop for highways. But they find oil mixed with water most to their liking. The more they eat, the faster they multiply, and the quicker the oil is cleaned up. When the bacteria re-enter the food chain, the oil is completely harmless.

But the trouble is that while petrophiles have huge appetites, they are fussy eaters. Each of the 70 different species that make up this family feeds only on certain parts of the petroleum hydrocarbons.

So scientists have been working to develop a "super bug" that will clean up the whole mess. They already have developed a strain that will eat about two-thirds of the chemicals involved in an oil spill. Now they are looking for one that will take care of the leftovers.

The fork-tailed storm petrel likes
oil, too. But far from being a finicky eater, this small, gray sea
bird scoops up anything and everything floating on or near the
surface of the water—oil, garbage and bits of plastic, along with the
usual sea bird diet of fish and plankton.

But when it is frightened, the fork-tailed storm petrel defends
itself by throwing up—on the theory that the bad smell will turn
off its attackers. This rather revolting habit makes it an ideal
spy in the sky for checking on oil spills in the open ocean.

In recent studies, scientists under the direction of Dr. David Manuwal
of the University of Washington caught fork-tailed storm petrels in
fine "mist nets" as they returned to their nests at night on the
Barren Islands north of Kodiak. When the birds were removed from
the nets, they dumped their dinners into the scientists' sample
bottles and were released to fly back for more.

By studying the glop, scientists can get an early warning of spills
that otherwise might not be spotted. And eventually, they may be
able to use the birds to find out where the oil came from.

The above article is excerpted from Alaska Tidelines (see credit at beginning).

Activity 4
Offshore Drilling

Background:

The 1969 Santa Barbara oil spill released a powerful surge of public
concern about the environmental effects of exploring for and pro-
ducing oil and gas from the outer continental shelf. This focus on
oil spills, while understandable and legitimate as far as it goes, has
obscured other subtler issues regarding offshore oil.

At the root of the problem is what resources we should give priority
to: offshore oil and gas? onshore oil and gas? coal? nuclear?
hydro? conservation? solar and other renewables? Commitments to
offshore leasing by governmental and industrial resources means
that those resources cannot be devoted to other energy sources.
Several national energy analyses have concluded that foreign oil
imports could be eliminated if the nation were aggressively pursuing
energy conservation.
Are the risks arising from offshore oil and gas acceptable in light of our ability to secure energy from other sources? Do we know enough about the cumulative effects of oil operations at sea to expand the offering of offshore lands by (say) twenty times in the next five years? More than half the U.S. total--more than 500 million acres--is off Alaska's coast.

Headline-grabbing, catastrophic oil spills can definitely have significant and long-term adverse effects on ecosystems, but routine discharges are even more serious. They can amount to millions of gallons over the life of a single well, and because their stressful effects are cumulative over a long period, they are more difficult to observe and measure. And today, when economic analysis is so prevalent, how do we quantify the value of a healthy ecosystem? For instance, estuaries and other coastal wetlands provide nursery grounds for 70 percent of the nation's commercial fish. But how can one calculate the value of wetlands in comparison to a barrel of oil, which has a price fixed in the marketplace?

What should our national offshore oil policy be? Should we continue at the present pace? Should we expand? Should we slow down while further research is conducted and alternatives explored? Oil is a mighty precious commodity, as well as a nonrenewable resource. What we use now will not be there for future generations. But any way we look at it, oil will be an important issue for students to grapple with both today and in succeeding years. What will be their solution?

(Adapted from "OCS Development: What Value--What Cost" by Michael Weber in Environmental Education Report, June/July 1982.)

Materials:
- pencils
- pens
- paper
- addresses of oil related agencies, oil companies, and political representatives
- local people involved in the offshore drilling issue
- worksheets:
  ...Above and Below the Sea Floor (4H)
  ...Oil In Troubled Waters (4I)
  ...Riches and Risks (4J)

Procedure:

1. Discuss the current offshore drilling issue. Encourage students to collect newspaper and magazine articles about what's happening now. Distribute the worksheet Above and Below the Sea Floor. Talk about the various offshore oil-planning areas. Which one is closest to your community? (Answers: 1. Diapir Field--a diapir (DIE-uh-peer) incidentally, is a strange mound of sedimentary rock that lies buried beneath the sea floor. It is formed by underground pressures and often contains oil; 2. 8; 3. 600 days; 4. Alaska-Canada border)

2. Invite people concerned with offshore leasing to present their points of view. Check with the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service, National Marine Fisheries, Native corporations, the oil companies, and environmental groups. Discuss community changes resulting from offshore drilling operations. If possible, obtain the films Kachemak Bay Story (about
the fishing and oil industry in Homer) and Uncertain Summer (about the preparation for the oil industry by the people in Yakutat and other southcentral communities).

3. Use the worksheet Oil in Troubled Waters to produce a program for your school or community or local TV station. Add examples or viewpoints from your local area to make the presentation more meaningful.

4. Now try the worksheet Riches and Risks for a brain teaser crossword. (Solution below:)

![Crossword Puzzle]

5. End the unit by having students write letters stating their points of view to legislators, oil companies, Native corporations, local city council, newspapers and the governor. This should encourage the development of language arts skills and stimulate critical thinking.
Unit Five
Community Planning Along Our Coasts and Rivers

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Objectives:

To help students:

- Read about Alaska's energy sources (Activity 1).
- Diagram local community energy sources (Activity 1).
- Survey home and school energy uses (Activity 1).
- Build and race a model sailboat (Activity 1).
- Map the transport of goods and services to the community (Activity 2).
- Write a theme about the effects of oil on transportation (Activity 2).
- Investigate local transportation sources and issues (Activity 2).
- Estimate the percentage of transportation that is water-dependent (Activity 2).
- Classify and investigate nearby wetlands (Activity 3).
- Interview people involved in wetlands management (Activity 3).
- Publish a wetlands newspaper (Activity 3).
- Record and graph recreational activities for a week (Activity 4).
- Compare and contrast different types of recreation (Activity 4).
- List recreational water safety needs (Activity 4).
- Investigate and contribute to local recreational needs (Activity 4).
- Choose a local problem and come up with a class solution and plan to implement it (Activity 5).
Communities in Alaska usually have a wide variety of local resources, and the people in these communities usually have a wide variety of opinions on how these resources should be used. Such diversity should make this unit exciting, as you and your class reach into the community to find out more about where you live. Do a community inventory (Unit One, Activity 1) and then select one or more of the following topics to study in depth: energy; transportation; wetlands; recreation. Though we have separated out different subjects, these areas overlap tremendously, and are all part of the whole situation that applies to your locale. The last activity in this unit contains guidelines for community problem solving.

A wide variety of personal needs and interests exists in any community, big or small. Sometimes, the needs of one group are in conflict with the needs of others. Careful planning can often result in everyone's needs being met as the community develops. We accomplish this planning almost automatically on the family level. Mothers and fathers are usually experts at this. As communities get larger, however, the problems become more difficult.

Community planning has not always been done properly in the past, resulting in increased costs, loss of income and loss in the quality of life to local residents. Some of our largest cities exhibit the same problem on a larger scale and consequently are losing population as people move away. Usually, the failure to plan for high quality community development results from the influence of powerful special interest groups that ignore the needs of others. Ideally, when people of good will get together to plan for the needs of everyone this should not happen.
Activity 1
Energy Sources

Note: Much of the material in this section is excerpted, adapted and updated from Alaska Tidelines, Volume III, Number 1, September 1980. Virginia Sims, editor. Published by the University of Alaska Sea Grant College Program, Copyright © 1980. Reprinted by permission.

Background:

The choice of energy sources has a tremendous influence on costs and lifestyles in coastal and river communities. Alaskans have a wide variety of energy sources among which to choose: oil, coal, natural gas, wind, solar, geothermal and hydropower. But at the same time, we will one day run out of nonrenewable sources such as coal, oil and gas. Therefore, this activity focuses on renewable resources, especially wind, because wind has been used on our seas and rivers for centuries to propel boats and ships.

A few commercial fishing boats in southeastern and southcentral Alaska are using WIND to beat the high cost of gasoline and diesel fuel. It wasn't too long ago when all the people fishing in Bristol Bay used sailboats. Onshore, windmills seem like a natural for Alaska, where the winds blow longest and strongest during the dark winter months when the need for power is greatest. Any area where the wind averages 10 to 12 miles an hour or more is a good place for a wind-powered generator. That includes most of Alaska's island, coastal and flat delta regions, as well as the high hills and narrow mountain passes in the Interior.

Historically, windmills have been used for grinding flour (that's where the "mill" comes from) and pumping water. Only recently have they been adapted to change mechanical energy into electric energy. (The most common way to make electricity is by using the power of wind, water or steam to turn a wheel to cut the force field between two magnets.)

A major problem with windmills, of course, is that they only work when it's windy. Nevertheless, at remote sites the power they generate can be stored in heavy-duty batteries for use on windless days. And when they are tied in with a village diesel system that takes over when the wind is still, a steady source of power is supplied at far less cost.
Solar energy also offers a lot of potential. What other state gets as much sun as Alaska in the summertime? And by having a large storage capacity, this power can be used right on through the winter. Solar power can be used for electricity as well as heat. The owner of Cripple Creek Gas Station in Fairbanks, for example, runs his entire household—washing machine, stereo, TV, lights, etc.—on sun-powered photovoltaic cells and storage batteries, supplemented by a generator, all through the year.

Hot springs and steaming volcanoes are outward signs of an underground source of power called geothermal (gee-oh-therm-uh) energy. The word means "earth" (geo) "heat" (thermal). And the energy is drawn from the fiery core of partly melted rocks and minerals that lie beneath the earth's cool crust.

The earth's crust is generally 15 to 30 miles thick. But it isn't all solid. Instead, it is made up of huge plates that move ever so slowly, sliding above and below each other, bumping together and drifting apart. In the process, the hot molten lava sometimes comes close enough to the earth's surface to heat ground water or even blast through in the form of a volcano.

Alaska is a young land still forming. You can feel it in our frequent earthquakes, caused by bumps and grinds deep inside the earth. In addition, our 88 active volcanoes and more than 100 known hot springs make Alaska a prime spot for the development of geothermal power.

Water from hot springs can be piped in to heat homes (as is already being done in Boise, Idaho, and Klamath Falls, Oregon). And if the water is very hot—356°F or more—the steam can be used to generate electricity.

A hot spring is formed when cold water sinks down through a fault in the earth's crust and passes through soft rocks heated by the layer of molten lava below. Then it rises through another fault and bubbles up as a hot spring. Resorts in Circle, Manley, Chena Hot Springs and other places in Alaska use hot springs directly to heat their cabins and bathhouses as well as their swimming pools.

At Pilgrim Hot Springs, 50 miles from Nome, the state has funded a project to determine the feasibility of using geothermal energy for various purposes. Now private proposals are being developed to use heat energy from the springs for, among other things, commercial-sized greenhouses and reindeer calving barns.

Across the Unalaska Bay in the Aleutians, the Alaska Power Authority has drilled an exploration well in a volcano and hit a "geothermal resource"—hot water in the ground—at 2000 feet. The next step will be to do a feasibility study, but researchers are optimistic that the ground water will be able to provide energy plentiful enough to supply Unalaska Dutch Harbor and to attract fish processors.
HYDROELECTRIC power is made by turning wheels with falling water. [Hydro (HIGH-dro) means "water" in Greek.] A small waterfall can do the job. But the higher the falls and the more water flowing over them, the more power that can potentially be generated. For this reason, a dam is usually built across a river or stream to back up the water in a man-made lake, so that the height of the falls and the water flow can be controlled.

Along with all its other resources, Alaska has more than one-third of the nation's remaining unused hydroelectric sites. But except for a few large projects, such as Snettisham near Juneau or Eklutna near Anchorage, most are designed to serve just one community.

Although the tidal power plan has possibilities, the proposed Rampart Dam is almost forgotten. Big dams can create big problems. Lands flooded by the back-up lake are lost to moose, caribou and other wildlife. And changes in the water flow can damage downstream areas as well.

Today, arguments are raging over a proposed project on the Susitna River, which would provide nearly twice the electricity now used in the whole Anchorage-Fairbanks railbelt area. Backers say that low-cost dependable power would bring industrial development to the area and much-needed jobs. Opponents argue that bigger isn't necessarily better, and that a number of smaller hydro projects would be less damaging to the environment.

The source of energy that's most often forgotten—yet offers some of the biggest potential—is CONSERVATION. It's cheaper to save a barrel of oil than to produce an additional barrel. Scandinavian countries, for example, use half the energy per capita that we do, yet they have a comparable standard of living. And it's not just our big factories, businesses and school buildings that are using energy. Personal use of energy—home heating, lighting, air conditioning, cooking, refrigeration and transportation—account for 37 percent of the country's energy use. Alaskans may not need much air conditioning, but they sure make up for it in transportation needs—both in terms of goods and services from the Lower 48, and of in-state and out-of-state travel and communications.

In summary, our energy choices and uses are a big determinant of our coastal and river life styles.
and community profiles. Our choices today will determine our future life styles and what resources will be available for future generations.

Information in Activity 1 is largely adapted from Alaska Tidelines (see credit at beginning).

Vocabulary:
- geothermal
- hydroelectric
- wind generator
- photovoltaic cells
- heat pumps

Materials:
- pencils
- paper
- wood blocks (1 per student)
- disposable aluminum pie plates or frozen food containers for keels
- sticks or slender dowels for masts
- masking tape
- glue
- scissors
- pieces of plastic or cloth for sails
- needles
- heavy-duty thread
- felt-tip marker
- thumbtacks
- paper clips
- knives
- books about sailing
- worksheets:
  ...Alaska's Powerhouse (5A)
  ...Sun Power in Alaska?? (5B)
  ...Energy Hog or Energy Hoarder (5C)
  ...Beating the Energy Crunch (5D)

Procedure:

1. Begin by discussing energy sources in Alaska. Pass out the worksheet, Alaska's Powerhouse. (Answers: 1. Aleutians: wind and geothermal, Southeast: water (hydro) and geothermal plus maybe wind; 2. 800 miles; 3. coal; 4. oil, natural gas, coal, water, and geothermal; 5. Barrow; 6. 2,500 miles, 60 miles; 8. answers specific to your community.)


3. Mention that conservation is an important way to save energy. Have each student try the worksheet, Energy Hog or Energy Hoarder. Discuss answers as a class. For more information on conservation, write to the U.S. Dept. of Energy, Editorial Services, Public Affairs Office, Wash. DC 20585; Alaska Div. of Energy and Power Devel., P.O. Box 3535, Anchorage, AK 99510; or Rich Seifert, Energy Specialist, Univ. of Ak, Coop. Ext. Serv., Eielson Bldg., Fairbanks, AK 99701.

4. Discuss energy sources in your local community. Have each student make a diagram of all energy sources and their uses in your community. Have each student list current prices of the various fuels and electricity costs. Discuss how energy influences life styles in your community. What do higher fuel costs mean to fishing boat captains, to canneries, to the price of fish?

5. Give students a chance to design their own energy systems. Pass out the worksheet Beating the Energy Crunch.
6. For a finale, have students make and race sailboats to illustrate wind power. To set the mood, read passages to the class about old-time or present-day sailing. The film Down to the Sea in Ships has footage of old-time sailing ventures and some of the incredible winds and seas they faced coming around Cape Horn. Have each student carve a wood block and a hole for the mast (twig or wood dowel). Glue the mast into the hole. Add a keel (piece of aluminum) with thumbtacks. Add paper clips to the keel for more weight. Use masking tape or needle and thread to attach the sail (piece of plastic or cloth) to the mast. Use a thumbtack plus some thread to attach the sail to the deck. Have students give their boats names and decorate them with felt-tip markers.

Pick a breezy day for a class regatta outdoors, or set up a tank with student wind power (or a fan) indoors. Have students experiment with different-shaped boats, different sail settings, different weights, different wind speeds. Students can award badges to captains of the fastest boat, slowest boat, ugliest boat, most beautiful boat, boats that flip over the most times, and so on. Ask students to predict what role sailboats (or sailing ships) will play in our future. (Adapted from "Science Activities in Energy," developed by the staff of Maurice Gould for the American Museum of Science and Energy.)

Activity 2
Transportation

Background:

Alaskans are great travelers. Each year they log thousands of miles traveling to jobs, meetings, berry picking, hunting, fishing, and to visit friends and relatives in a state so big that it covers five time zones (though for convenience most of the state is now in one time zone). Additionally, most of Alaska's goods and supplies are transported from the Lower 48 by ship, truck or plane. Studies have shown that 47 percent of Alaska's energy budget goes for transportation.

Each community has a unique transportation system, oftentimes consisting of boats, planes, three-wheelers and snowmachines. Many communities are deciding whether to tie into the central road system, which would make it easier for them to "get to town," but would also make it easier for "town" to get to them.

Materials:

- Alaska map
- world map
- chalkboard and chalk
yarn
- felt-tip markers
- thumb tacks
- slips of paper

Procedure:

1. Ask students to list on the chalkboard all the different means of transportation they can think of. Circle the ones most important to your community.

2. List all the goods and services arriving in your community. Have students inventory the food and materials found at home and school, listing the states or countries of origin.

3. Compile your results on the world map: on little slips of paper, write the names of the items on your list of goods imported into Alaska. Place these tags in countries or states on the map that export these products to Alaska. Connect these places to Alaska with yarn.

4. Point out on the Alaska map how these products get to your community.

5. Estimate the percentage of transportation that is water-dependent. Also estimate what percentage of the products' costs is from transportation. What would happen if fuel costs escalated tremendously? What would happen to transportation within your community? At what point would products from the "outside" be unaffordable? What jobs would be affected?

6. Have students write themes on "The Day that the Oil Stopped Flowing," imagining what their communities would be like without the oil and gas that transport people and goods. What would happen to subsistence, sport and commercial fishing?

7. Have students pick a local transportation issue to explore. Is the barge, ferry or riverboat service adequate? Is your community expecting a new road, airport or harbor? Do you need additional trails along or to the beach, the river or a nearby lake? Are snowmachines and three-wheelers being used to carry and haul supplies as well as for recreation? Are there conflicts between people who use the trails for skiing and hiking and people who drive motorized vehicles along them?

Students can collect information from a variety of viewpoints. Visit the site (if possible) and inventory and photograph what is there now; brainstorm alternative solutions; come up with a class solution; and develop a plan to implement that solution, which may include talking to the decision makers, writing letters and/or a news article, preparing a slide show or charts and graphs. Discuss what will make the most impact. Often, just talking to the right person is more important than anything else. Then implement your plan. Evaluate it afterwards. What would the class do differently the next time?
Activity 3
The Wetlands Gazette

Background:

Most of Alaska is wetland, which means land that is wet most of the year and is occupied by plants and animals that prefer wet soil. All wetlands have either an impermeable or semi-permeable substrate at the bottom—such as bedrock or permafrost—through which water either cannot escape or escapes very slowly.

Alaska has a variety of wetland types: coastal wetlands; wet tundra; muskegs; and rivers, lakes, and marshes.

Rivers, lakes and marshes are common in Alaska’s Interior. Cattails, horsetails, mare’s tails, sedges, rushes and grasses are typical freshwater marsh plants.

Rivers and lakes are called wetlands, too, because they host a variety of water-loving plants and animals—and the land underneath these water bodies is definitely wet.

Wet tundra, one type of wetland found in northern and western Alaska, is characterized by low-lying plants such as grasses, sedges, cranberry, blueberry, crowberry, lichens and willow.

Muskegs, or bogs, are freshwater wetlands that contain cold, acidic water and spongy or floating mats of vegetation, such as sphagnum moss, cranberry, sundew (a predatory plant) and Labrador tea. Black spruce are often associated with Interior bogs. Lodgepole pine is found in muskegs in Southeast Alaska.

Coastal wetlands include tidelands, estuaries, salt marshes, river deltas and barrier-island lagoon systems.
Tidelands are coastal lands washed by the tide. Tidelands include sand, mud and rocky beaches, plus saltwater marshes. Salt marshes are formed where salt water washes over sedges and grasses. Estuaries are formed where rivers and streams meet the sea. They include bays, lagoons, rivers and adjacent river delta wetlands—which combine together to form extremely productive areas. The mixing of salt and fresh water in the shallow estuarine waters creates a warm soup of nutrients and food, gently stirred by wind and tide. Estuaries are the nursery grounds for the great majority of fish and shellfish.

Barrier-island lagoon systems are important to the ecology of the Arctic coastal plain, the Alaska Peninsula, and the Copper River Delta. They provide a protected lagoon system where fish, migratory birds and marine mammals can feed on abundant invertebrate and fish resources.

Swamps, a type of wetland characterized by flooded trees, are found in southeastern United States, but not in Alaska.

All these wetland types are generalized. They integrate and overlap. River deltas, for instance, may include freshwater marsh, tundra, tideland (saltwater marsh and sandy beach), plus be part of an estuarine system. Wetland terms are quite arbitrary, but they do serve to familiarize students with wetland concepts.

People nationwide are beginning to realize the value of wetlands economically, ecologically, recreationally, aesthetically and educationally. In the not-too-distant past, many people simply assumed that wetlands were no more than wastelands to be drained, dredged and developed. As a result, vast areas of wetlands were routinely destroyed as developmental pressures increased for roads, homes, airports and factories. Unfortunately, wetlands are still being lost today, despite the fact that more and more people are realizing the necessity to protect our remaining wetlands.

Wetlands are critical fish and wildlife habitat. The commercial fishing industry depends on the protection of coastal wetlands, which are breeding and nursery areas for 70 to 80 percent of commercially caught fish and shellfish. Alaska is also one of the prime duck and goose "factories" for North America. Our wetland habitats provide nesting and rearing areas for millions of waterfowl and shorebirds. Moose, caribou, mink, muskrat, beaver and berries are but a few of the many other animals and plants that depend on wetlands.

Other wetland values include subsistence and sport hunting, fishing, trapping and recreation, as well as being an extraordinary tourist attraction. Wetlands decrease or eliminate downstream flooding by acting like a sponge, soaking up excess rain and snow-melt. Wetlands are natural storm buffers as they physically shield coastal lands from the effects of high winds and seas. Surface water that collects in wetlands gradually seeps down to replenish underground reservoirs, which often serve as community water supplies. Wetlands also act as biological filters, straining out pollutants such as sewage, chemicals, silt and other garbage (all within limits!).
In the past, development on wetland areas has been more or less helter-skelter. Consequently, just about every community has examples of development that should have perhaps occurred in other places. The prime mechanism for wetland regulation is the so-called "404" regulatory permit program. The U.S. Army Corps of Engineers manages these 404 permits, and anyone wishing to fill, dredge or construct a project on a wetland has to get a permit from them. The Corps of Engineers works with the applicant by notifying the public; reviewing the site; discussing the issue at a public hearing; evaluating the site for conservation, economics, aesthetics, environmental concerns, fish and wildlife values, flood damage prevention, public welfare, historic values, recreation, land use, water supply, water quality, navigation, energy needs, safety, and food production; suggesting changes to meet 404 regulations; and issuing the permit.

Vocabulary:

- tundra
- bog
- muskeg
- swamp
- tideland
- estuary
- marsh
- delta
- barrier island
- lagoon

Materials:

- paper
- pencils, pens
- copy machine
- typewriter
- film
- camera
- worksheets:

...Local Wetlands (5E)
...Life in a Wetland (5F)

Procedure:

1. Discuss the meaning of wetlands and point out examples of nearby wetlands. Distribute the worksheet Local Wetlands and have students identify types and categorize local examples. (Answers for the types: 1. wet tundra; 2. coastal wetlands; 3. rivers, lakes and marshes; 4. muskeg)

2. Discuss wetlands values. Distribute the worksheet Life in a Wetland and have students write their own descriptions of the drawing. How many different ways are people and animals using the wetlands? What conflicts may exist between the different uses?

3. Discuss the need for educating your community about wetlands values. Suggest the idea of printing and distributing a Wetlands Gazette. You'll need students to interview community members, write articles, take pictures, draw cartoons, do layout and printing and distribute the paper. If you have time, students might want to ask a local bank or a community resident for a loan to cover newspaper expenses; then sell advertisements; and sell the paper to pay back the loan or raise money for a class project, all of which would be a great lesson in economics.

4. Develop a plan for producing the Wetlands Gazette. Ask the students:
5. Produce your Wetlands Gazette and distribute it in your community. Be sure to send copies to the local or area television and radio stations and newspaper offices. What is the community reaction? Figure out a way to measure the success of your Wetlands Gazette by questionnaires, verbal or written comments.

Activity 4
Recreation

Background:
Recreation is not only a multi-million dollar business, but it consumes much of our spare time as we boat, hunt, fish, scuba dive, ski, hike, swim, walk, canoe, knit, carve wood, watch TV, play video games, read books, jog, drive cars, ride three-wheelers and snowmachines, mush dogs, or fly planes and hang gliders. The type of recreation we choose affects the environment directly, as we move through rivers, ocean, wetlands, forests and mountains. We affect the environment indirectly as resources are used up to manufacture recreational equipment, transport it, sell it and maintain it.

The type of recreation that community residents participate in affects their character and way of life. Many Alaskans spend much of their recreation time outdoors. Safety is a most important consideration, not only on land but in the water. Alaska has more per capita water-related accidents than any other state, and many of these deaths occur during recreational pursuits.
Materials:

- chalkboard and chalk
- paper
- pencils
- graph paper

1. List on the chalkboard all the different types of recreation your students participate in. Have them keep track of the amount of time they spend in each pursuit for a set length of time (such as a week).

2. Compile this information on a class chart. Pass out graph paper and have students graph their class's recreation for the week.

3. Compare and contrast the different types of recreation. Ask students the following questions:

   - How would this chart change with the seasons?

   - Which forms of recreation require the most energy resources to maintain? (oil, gas)

   - Which forms require the most energy to manufacture? (oil, gas resources)

   - Which forms of recreation require the most energy (human) to participate?

   - Which forms of recreation are water-dependent?

   - Which forms of recreation are the most damaging to the environment?

4. Discuss why recreation is important (peace of mind, health of body) and talk about the increase in recreation in modern times due to higher standards of living and to the fact that for major portions of the population, time need not be completely absorbed in obtaining food, clothing and shelter.

5. Bring up the need for water safety in water-dependent forms of recreation. Have students brainstorm all the ways they can think of to be safe around the water. List these on the board. (Include life jackets, survival suits, knowing how to swim, proper boat handling, knowledge of water and weather conditions. See safety and survival portions of Units 7 and 8.)

6. Discuss local recreation needs. Does your community need a swimming pool? More trails along the beach and river? A waterfront park? Square dances? A youth center? Water safety training? Select an issue the students are interested in and then follow the steps mentioned in Activity 5. Procedure 3 of this unit, to study the topic in-depth and maybe contribute toward improving local recreation opportunities.
Activity 5
Community Issues

Background:

Looking at local community issues can be one of the most exciting and rewarding topics of the school year. Students have a chance to become an integral part of the community as they contribute their ideas and expertise to issue resolution. They also learn about political realities in the process. Reading, writing, mathematics and speaking skills become very important, as students try to comprehend all the intricacies of a particular issue while attempting to influence its outcome.

By researching a variety of viewpoints, students develop critical thinking skills that should help them throughout life. Decisions in Alaska are made in a variety of ways, depending on local culture and politics. As students learn to be effective with community action, they are acquiring the confidence and self-esteem they need in order to develop into productive members of society.

Materials:

- News clippings
- Resource people
- Chalkboard and chalk

Procedure:

1. Begin a list on the board of local issues. Refer back to the community inventory (Unit 1, Activity 1). Which of these issues are of primary interest to you? Is a new commercial development planned? Is a power project or road coming to your community? Where are new houses being built? What’s happening to local wetlands? Do you need more trails or parks? Is public access assured to local beaches, rivers and lakes?

2. Decide which issue to study. Students may want to pick a comparatively minor problem where they have a greater chance of influencing the outcome, or they may want to become involved in a community or regional problem that may be more controversial and exciting to investigate.

3. Follow these problem-solving steps:

   a. Collect in-depth information from a variety of viewpoints. Visit the site and inventory and photograph what is there now. Read pertinent books, news articles and research papers.

   b. Brainstorm alternative solutions.

   c. Come up with a class solution. Suggest that students state their concern in a positive manner.

   d. Develop a plan to implement that solution, which may include talking to
the decision makers, writing letters and/or a news article, preparing a slide show or charts and graphs. Discuss which action will have the most impact.

e. Implement your plan.

f. Evaluate your success (or lack thereof!). What would the class do differently the next time? You may need to go back and try again!