

ALASKA OIL SPILL CURRICULUM 7-12

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WARNING: OIL IS A HAZARDOUS SUBSTANCE

In most of our activities, we recommend the use of "pretend oil: made of black tempera paint and vegetable oil. As spill educators, we do not want to be part of the oil spill problem! One pint of used oil can produce a slick approximately one acre in size. Only one part per million contamination will spoil the taste and odor of drinking water. At this ratio, it would take a pint of oil to contaminate 125,000 gallons of drinking water. That is more than 15 people drink in a lifetime. Oil has been shown to cause cancer in mice. Oil is currently considered to be a hazardous material. Used oil is regulated by both state and federal regulations in the event of a spill or discharge. It is also regulated under current hazardous waste regulations pertaining to its use as a fuel burned for energy recovery. Some of the most toxic fractions of oil are the aromatics (the odor from oil). In addition, waste oil can contain heavy metals such as lead, chromium and cadmium. So limit your students' exposure to crude oil as much as possible. Open a jar briefly so they can identify the smell of aromatics - then close it up and ventilate the room.

Use gloves when you are handling crude or waste oil. If you get any oil on your skin, wash it off immediately with soap and water. Wash oiled clothes before wearing them again. Do not stick oily rags in your pockets. Do not use kerosene, paint thinners, or waterless cleaners on your hands when trying to clean up the oil as they may remove the skin's natural protective oils and can cause dryness, irritation and possibly more serious effects.

DISPOSE OF OIL PROPERLY. Take waste oil to service stations or community collection sites for recycling. If you use newspapers for floor coverings during experiments, the resulting oily newspapers can be burned for heat by someone who has a wood burning stove. Oiled clothing or rags can be washed and used again. Other oil wastes can be stored in metal containers for spring community clean-ups and hazardous waste pickups **IT IS IMPORTANT NOT TO PUT OILY WASTES IN LANDFILLS** where they will eventually leach into the water table. Also, **BE SURE YOU GET ALL THE OIL OUT OF THE WATER** before you pour it down the drain. Oil absorbant pads are perhaps the best way to get oil out of the water. They should be available at marine and hardware stores.

In the event of a spill or discharge, or if you have any questions or concerns, contact the Alaska Dept. of Environmental Conservation (DEC) at 907-269-3063 (Anchorage); 907-451-2121 (Fairbanks); 907-465-5340 (Juneau); or toll-free at 800-478-9300. See more information on their Spill Prevention and Response website: <http://www.dec.state.ak.us/spar/spillreport.htm>.

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INVESTIGATING THE OIL SPILL

By Belle Mickelson

SUBJECTS: All

DURATION: Minimum of 2 periods

OBJECTIVES: Students will research the Exxon Valdez oil spill and other spills around the country and the world by reviewing news clippings, magazine articles and videos. Students will make a journal of their experiences and impressions.

BACKGROUND: Good Friday, March 24, 1989, the tanker *Exxon Valdez* hit the rocks of Bligh Reef spilling 11 million gallons of oil on the waters of Prince William Sound. The oil continued on down the coast eventually touching over 1,000 miles of beaches including those of the Alaska Peninsula and Kodiak Island. Exactly what happened varies on the news source.

PROCEDURE:

1. Ask the students what they remember about the *Exxon Valdez* oil spill which occurred in the spring of 1989. Pass out the Alaska Department of Fish and Game "Special Oil Spill Issue," sample news articles, and any other magazines (see appendices at end of curriculum). Note the differences in reports of what has happened.

2. Have each student make a journal and write out their initial impressions of the spill.

3. Introduce the video [Voices of the Sound](#). This video was made by Mike Lewis and David Grimes shortly after the spill happened. Footage by Joel Bennett at the beginning shows the beauty of Prince William Sound and its wildlife. Terms to mention beforehand include CDFU (Cordova District Fishermen United) whose role in the spill is described in a news article found at the end of the curriculum. Have the students point on the



Photos taken in 2005 at Herring Bay in Prince William Sound show oil residue from the 1989 Exxon Valdez spill. Photo by Jim Payne, Payne Environmental Consultants, Inc.

MATERIALS:

- News clippings, magazine articles
Voices of the Sound
- Paper and covers or notebooks to make journals
- Markers/colored pencils
- Map of Alaska
- Blackboard
- Bulletin board

INVESTIGATING THE OIL SPILL

map the communities in Prince William Sound. Cordova is a fishing community; Valdez has oil and tourism industries in addition to fishing; Whittier has tourism and fishing; Chenega and Tatitlek are Native fishing communities which depend on subsistence hunting and fishing. Outside the Sound, impacted communities include Kodiak, the country's largest fishing port, Seward, Homer, Seldovia, Port Graham, and English Bay on the Kenai Peninsula, and other small villages along the Alaska Peninsula. Ask the students how they would feel if their beaches (ocean, rivers, lakes) were oiled? Then show Voices of the Sound to see how the Cordova fishermen and women felt. Have one of the students write in their journals some of their impressions.

4. Show the ARCO/Alyeska videos. These describe environmental considerations, clean-up procedures and the industry's revised response system to a spill. Explain that in this unit, they will be studying a variety of clean-up techniques.

5. Encourage students to clip current events about oil spills in their states and in other countries around the world for a class bulletin board.

6. Hand out 5" x 10" cards to each student. Ask students to summarize the two video tapes they just saw. Collect the cards and use them to evaluate students' understanding.

EXTENSION:

1. Geography/Language Arts: Write letters to foreign newspapers asking for articles about the Exxon Valdez oil spill – and oil spills in their countries. Research in your library or museum, articles about spills around the world. (Suggested by Margaret Ladd, Homer, Alaska).

2. Language Arts: Invite a reporter into class to describe investigative journalism/reporting. Ideally, interview a reporter that worked on the spill. Or watch video footage made by a news team such as America's Biggest Oil Spill (see bibliography).

ALASKAN ECONOMY AND OIL

BY: Elizabeth Trowbridge

SUBJECTS: Social studies, economics

DURATION: 1 period

BACKGROUND: Alaska's economy has a history of "boom or bust" cycles. The most recent "boom" has been the oil discovery at Prudhoe Bay. Since oil has been moved down the trans-Alaska pipeline, Alaskans have enjoyed a very prosperous lifestyle. Aside from the oil spill, the fishing industry has been a relatively stable economic base for Alaska. The main difference between these economies though, is that one is based on a non-renewable resource and one on a renewable resource. Even though fisheries provide the most jobs in the state, the oil industry provides the most revenue to the state government and funds most of the state's fiscal budget. It is time we looked at what will happen when the oil runs out.



MATERIALS:

- Worksheet: Alaskan Oil Finance

PROCEDURE:

1. Make a bubble diagram with the students about the source of local government revenue and spending. Which services does government provide? Which are most important to you? Which ones would you cut from the budget? How much of Alaska's economy is based on oil production? What does this mean for other states and other industries? What does this mean for the environment? Generate a discussion based on student responses.
2. Hand out the Alaskan Oil Finance worksheet. Ask students what it means to depend upon one major non-renewable resource for the state's economy? What happens when the oil runs out? What are some alternatives? Have students respond to these questions in their journals.
4. To evaluate students' understanding of the state economy, use question "C" of the worksheet to initiate a class discussion.

ALASKAN ECONOMY AND OIL

Link to article 8/11/89, Anchorage Daily News:

www.adn.com/evos/stories/EV400.html

SPILL FORCES EXXON ECONOMY ON KODIAK: Some Gain, Some Lose in the Cleanup and the Claims. By CHARLES WOHLFORTH

ALASKAN OIL FINANCE WORKSHEET

The following information is from the Alaska Oil and Gas Association website revenue page (www.aoga.org/revenue.html):

"State revenues from the oil and gas industry are projected to reach a record high of \$4 billion in fiscal year 2006."

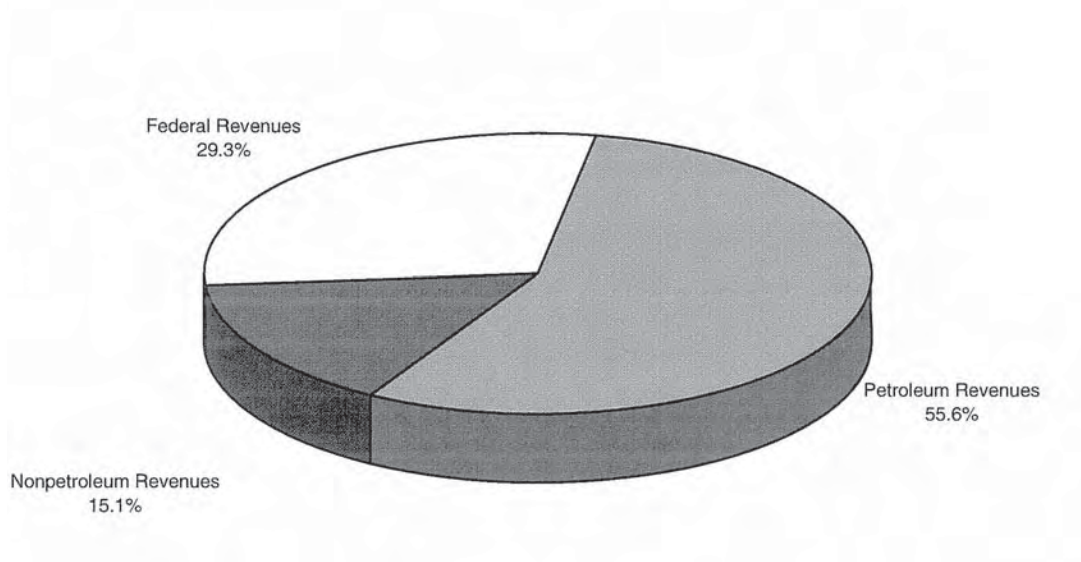
"Since the completion of the trans-Alaska oil pipeline, petroleum revenues to the State of Alaska have averaged 84 percent of the state's unrestricted general fund. Total petroleum revenues are projected to be 90 percent in fiscal year 2007."

1. The chart below shows where the State of Alaska's general fund revenues came from during the fiscal year 2006. What percentage of the state's income was paid by the oil and gas companies?

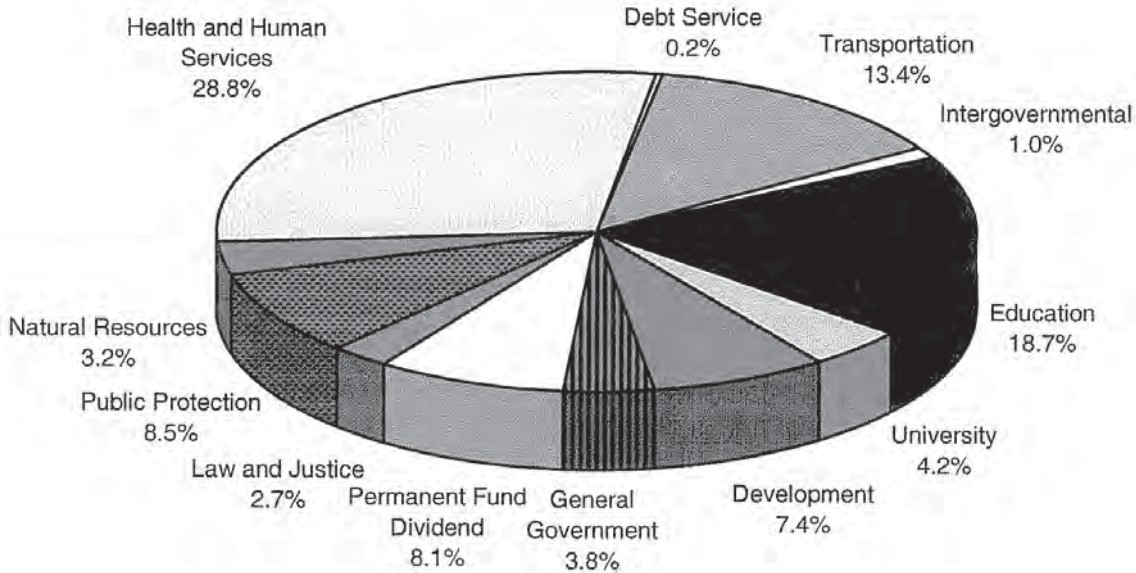
_____ %

2. If this percentage equals \$4 billion, what would be the total state revenue for that year?

\$ _____



ALASKAN OIL FINANCE WORKSHEET



A. This chart shows that for fiscal year 2006 the State of Alaska spent nearly half of its general funds in just two areas. What are they? _____

B. What general area gets the least amount of money? _____

C. If you were a state legislator, where would you spend more money? _____

Where would you spend less? _____

Discuss how these figures below, from the 1989 proposed operating budget, differed from 2006:

Development: 10%
 Transportation: 8%
 General Government: 12%
 Education: 38%
 Health and Social Services: 14%
 Natural Resource Management: 6%
 Public Safety and Courts: 12%

OIL SPILL HUMOR

BY: Elizabeth Trowbridge, adapted from Alaska Sea Week Curriculum Series Vol. VI

SUBJECTS: Social studies, art

DURATION: Minimum of 2 periods

OBJECTIVE: Students will draw a cartoon reflecting an oil spill issue.

BACKGROUND: The *Exxon Valdez* oil spill of March 24, 1989, was the largest oil spill in U.S. history. There were conflicting opinions on all aspects of the spill. Naturally, this accident had many political ramifications and was a highly emotional event for all involved. Cartoons and/or a sense of humor can be very effective politically. Humor helps us all bear the unbearable and makes life a little more enjoyable. Political cartoons dramatize the opinions of the people and give us a window into history.

MATERIALS:

- Paper
- Pencil
- Pens

PROCEDURE:

1. Brainstorm with the class about oil spill issues: who were/are the major players? What were the most obvious issues? What were the feelings of affected people? etc. The list may include: Exxon, Alyeska, fishermen/women, local communities, wildlife, Alaska's dependency on the oil industry, the captain of the *Exxon Valdez* being charged with driving while intoxicated, the closing of fisheries, etc.
2. Select and research one issue. Use newspaper clippings, magazine articles, videos and any other information collected regarding the oil spill. Students may wish to interview local officials or community members.
3. Decide on a point of view or a proposed solution, i.e. environmentalist, Exxon shareholder, pro-development, fisherman/woman. Then draw a cartoon to illustrate your point of view.
4. Display the results on a bulletin board. Print them in the school paper on an editorial page, and use them for covers of the oil spills journal each student will keep.

OIL SPILL HUMOR

EXTENSIONS:

1. History/ social studies: Have students research political cartoons in history. How have these "editorials" reflected public opinion of the times? One famous cartoonist who used his art to influence public sentiment was Ding Darling. A wildlife refuge on Sanibel Island, Florida now bears his name. What are the majority of the cartoons drawn concerning the oil spill saying about the public attitude toward the oil spill? Exxon? development? wildlife? the current administration? This could be a class discussion or a small research project with a written product.
2. Social Studies/ language arts: Have students pick a point of view and then write editorials, or letters to the editor, expressing this view or concerns relating to the oil spill. This can be an ongoing project in which the students write after each activity of the oil spill curriculum or once at the beginning and once at the end (to see if their views or understanding of the issues have changed or developed). The letters can be submitted to the school paper or to the local community paper. Include the students' cartoons.

SHEEN - OIL - MOUSSE

BY: Jane Middleton

SUBJECTS: Science, math

DURATION: 1 period

OBJECTIVES: Students will use mathematical skills to compute the size of an oil slick. Students will learn about the three fractions of spilled oil and its effect on organisms.

BACKGROUND: The *Exxon Valdez* oil spill was a major environmental catastrophe. As many as 300,000 seabirds, and several thousand sea otters perished. One-hundred and fifty bald eagles were found dead and many more undoubtedly perished from eating oil-infested bodies of seabirds. Over 1,000 miles of intertidal habitat was badly fouled. Land mammals were impacted by browsing in the intertidal area. Intertidal life died from oil suffocation, oil ingestion, and from trampling by 10,000 oil spill workers.

The oil slick that formed after the spill soon began to change physically and chemically. An undetermined amount of the lighter compounds evaporated into the air. The remainder of the toxic oil spread out from the main slick as fingers of a very thin iridescent sheen on the surface of the water. This layer of sheen can be deadly to seabirds and other marine life.

As oil on the water is agitated by wind and begins to weather, it changes, in about 2 weeks time, to a thick, gel-like substance called mousse. Mousse is a mixture of oil with air and water.

Following the oil spill, the media featured pictures of dead birds covered with heavy oil or with mousse, leaving the impression that only the heavy fractions of oil were capable of killing birds. The simple experiment in this activity should bear a clear message to



MATERIALS:

- 1 cubic centimeter 10W-40 motor oil
- 1 quart sea water
- Hand whisk or egg beater
- 1 large bowl
- Eye dropper
- Graduated cylinder
- 2 culture bowls, 6" diameter
- 4 seabird feathers
- 1 large, flat pan or cafeteria tray
- 4 small rocks
- 1 oil absorbant pad
- Dennis Kelso quote from Curriculum Introduction

SHEEN - OIL - MOUSSE

students that the iridescent sheen that develops around boats when fuel is spilled or oily bilge is pumped overboard is also deadly to seabirds. Ask your students how often they have witnessed this practice. You may develop a lively and productive discussion about ways to avoid fouling the water from fishing and pleasure boats. Perhaps students will be inspired to lead a harbor clean-up campaign complete with an educational program for harbor users.

PROCEDURE:

1. Remind students that oil is toxic - a hazardous substance they should breathe as little as possible and not touch.

2. To demonstrate the effect of the oil spill on birds, pour a layer of salt water about 1" deep into each of the culture bowls. Have a student drop a single drop of motor oil onto the surface of the water in one of the bowls. Dip 2 seabird feathers into the bowl of plain salt water (control). Remove them, place one on top of the other, and place in a well-ventilated or sunny spot to dry. Dip two clean feathers into the bowl of sheen. Remove them. Can you see the oil? Place one on top of the other and set alongside the control feathers to dry. (**SAVE THE OILED SALTWATER FOR PROCEDURE #5**). What happened? Did the feathers dipped into clean sea water dry quickly and separate from one another? Did the oiled feathers remain matted together?

This is a very significant lesson that illustrates that even a very minute amount of oil may cause bird feathers to become matted together. In this condition, they cannot be fluffed for warmth and the bird may die of hypothermia.

3. Demonstrate the way oil leaking from a tanker spreads out to form a slick on the surface of the water. Pour a layer of sea water into the large, flat tray. Drop a cubic centimeter of oil on to the water's surface.

4. Have students compute the area of the slick which forms. Then compute the area of a slick formed by a liter of oil by multiplying by 1000. But the Exxon oil spill was measured in gallons! There are 3.785 liters in one gallon. Have the students figure the size of a slick formed by one gallon of oil. Then they can multiply by 11,000,000 to get the size of the slick in square centimeters. Next, tackle the problem of converting sq. cm. to sq. mi. (1 sq. ft. = 929 sq. cm. and 1 sq. mi. = 27,900,000 sq. ft.)

5. Read the quote from Dennis Kelso, Commissioner of the Department of Environmental Conservation (DEC) found in the curriculum introduction. Discuss the effects of minute amounts of oil in our environment.

SHEEN - OIL - MOUSSE

6. TAKE THE OILED WATER FROM PROCEDURES #2-4 and pour into a large bowl. Mix with egg beater for at least 20 minutes. The froth which forms on top is mousse. Have the students skim the mousse off and measure it. Is it more or less than the amount of oil that was poured into the bowl? Ask them what happens to an oil slick at sea that is agitated by high winds and strong seas for 2 weeks or more, as was actually the case with the Exxon oil in the Gulf of Alaska. (This experiment can be done in a blender, but the oil will be impossible to clean out completely. Any oiled items—bowl, beater, tray—should not be used for food ever again).

Thick, foamy mousse blew ashore and remained in the intertidal areas. Pour some of your mousse onto a few dry rocks to illustrate its tendency to cling to the shore rather than wash back out to sea. **(SAVE YOUR OILED WATER AND ROCKS FOR CRITTER CLEAN-UP AND CLEAN-UP TECHNOLOGY—the next two activities).**

7. Begin a discussion or have students write in their journals on the effects of mousse on intertidal life:

a. What happens to animals such as chitons, snails, and limpets which normally crawl across the surface of rocks looking for food? Do you think they can remain attached and move in this gooey stuff?

b. Barnacles normally attach themselves to rocks and reach their fragile legs out to capture food from the water. What happens to the barnacles if they are covered with mousse? Can the barnacles feed? How long can they live without feeding?

c. Many shorebirds feed on the barnacles. What happens to the shorebirds if their barnacle food is covered with mousse?

d. There are many kinds of crabs which live on the shore. Crabs breathe by means of gills which lie just under the top shell. What will happen if mousse gets into their gills?

8. Follow-up this activity with Critter Clean-up, Clean-up Technology, Intertidal Zones, and the Field Trip to the Beach.

9. Have students summarize what they have learned in their journals. How have their impressions of the oil spill changed?

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SPECIES OF DEAD BIRDS RETRIEVED AFTER THE EXXON VALDEZ OIL SPILL, 1989

GRAPH THIS CHART

TABLE 1. Proportions (%) and total numbers of birds retrieved from Prince William Sound (PWS), Kenai Peninsula (KP), Barren Islands (BI), Kodiak (KOD), and the Alaska Peninsula (AP) between 25 March and 13 October, 1989.

Species group	Area					Total before Aug 1	Total after Aug 1
	PWS	KP	BI	AP	KOD		
Loons	8.7	1.8	0.3	0.4	<.01	1.5	<.01
Grebes	11.8	1.6	0.2	0.3	0.1	1.7	<.01
Procellariids	0.4	4.8	0.7	1.1	4.9	2.9	50.7
Cormorants	16.0	4.3	0.4	0.6	0.7	3.0	1.0
Sea Ducks	24.9	8.4	0.7	1.6	0.7	5.3	0.3
Gulls	1.8	5.5	0.5	1.2	2.4	2.4	21.6
Murres	15.2	58.1	88.3	89.0	84.6	73.7	7.1
Murrelets*	11.6	4.9	3.7	0.6	0.5	2.2	2.0
Guillemonts	4.7	4.6	1.2	1.6	0.8	2.2	0.4
Puffins	0.0	1.5	0.2	0.2	1.4	0.9	13.8
Other alcids	0.8	1.6	3.6	3.3	2.9	1.7	1.7
Other birds	4.1	2.9	0.7	0.1	0.9	2.5	1.3
Total numbers							
Retrieved	3,358	6,225	2,163	8,881	8,548	29,175	6,940
Identified	2,882	5,174	1,922	8,691	8,200	26,869	6,238
*Includes 167 old carcasses that were oiled and apparently killed before 1 August, but retrieved after 1 August. Total does not include 31 oiled birds found on Middleton Island and 1,091 birds that died at oiled-bird rehabilitation centers.							
* <i>Brachyramphus</i> murrelets only.							

Reprinted from AUK 197(2) "Immediate Impact of the 'Exxon Valdez' Oil Spill on Marine Birds" by J.F. Platt, C.J. Lensink, W. Butler, M. Kendziorek, and D.R. Nysewander.

Use this chart to construct a graph of bird casualties discovered immediately following the *Exxon Valdez* oil spill. Compare these figures to other figures available from research conducted following the Oil Spill. See the Appendix for a complete list of research conducted by scientists funded by the *Exxon Valdez* Oil Spill Trustee Council.

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CRITTER CLEAN-UP

Adapted from: Sea World Education, used with permission. Revised by Beth Trowbridge, PWS Science Center, 1995

SUBJECT: Science

DURATION: 1 period

OBJECTIVES: Students will: 1) identify ways oil spills can affect wildlife adversely; 2) demonstrate a variety of ways humans can remove oil from birds' feathers, animal fur, hair and leather; 3) graph data collected on injured wildlife species.

BACKGROUND: The impacts of environmental pollution are often difficult to see. A major oil spill, however, provides dramatic evidence of potential impact to wildlife. Examples include damage to feathers, killing of embryos when oil seeps into eggs, suffocation of fish when gills are clogged, and death to marine and terrestrial animals by ingesting food and water contaminated by the oil.

People are involved in efforts to prevent oil spills and their consequences. They also are involved in efforts to "clean up" after such spills take place. Such actions are not always successful, and sometimes they have unfortunate consequences as well. For example, the process of using detergents to clean oil from the feathers of birds may also damage the birds' feather structure and arrangement and thus the birds' waterproofing. Birds may also be more susceptible to disease during this time of stress, and may be weakened to the extent that it is more difficult for them to secure their necessary food and water. Also, food and water quality may be affected.

Oil spills are just one example of the kinds of pollutants that can have adverse short and long-term effects on wildlife, people and the environment. The impact of DDT on food chains is well-known. DDT's influence on thinner egg shells in bald eagles and other birds is well documented. Pollution is just one factor which contributes to threatening, endangering, and eliminating species of flora and fauna.



MATERIALS:

- Heavy weight motor oil
- 4 hard boiled eggs
- Small container
- Rubber gloves
- Cooking Oil
- Paprika
- Five large bowls
- Water (You may substitute leftover oil slick from Sheen-Oil-Mousse lesson)
- Three types of detergent: a mild hand soap, a powdered laundry detergent, and a grease-cutting dishwashing detergent
- Feathers
- Leather
- Fur
- Hand lens or microscopes
- Paper or journals
- Pencils
- Newspapers
- Oil absorbant pads
- Funnel

CRITTER CLEAN-UP

PROCEDURE:

1. Before class, fill the five bowls with water. In the first bowl pour a slick of cooking oil mixed with 2 tbsp. of paprika (to give the oil color and make it easier to see) on the surface. (You may also use the leftover oil slick from the Sheen-Oil-Mousse lesson). Leave the second bowl as just plain water. Label the other three bowls #1-3. Dissolve a tbsp. or two of one of the detergents in each bowl. Do not let the students see which solution is in which bowl. (They are secret or mystery solutions).

2. Put enough motor oil in a small container to submerge three hard-boiled eggs. Take another egg and roll briefly in the oil and then leave it on a newspaper for 30 minutes. Put the eggs under a good light and watch closely. Remove one egg after five minutes and examine it – before, during and after peeling off the shell. Try to remove the excess oil from the outside before attempting to peel the egg. Remove the second egg after 15 minutes and the third egg after 30 minutes, repeating the procedure, examining each carefully. Compare the results to the fourth egg which was merely dipped in the oil. Discuss observations. What effect could oil have on the eggs of birds nesting near the water? **WARN THE STUDENTS THAT MOTOR OIL IS A TOXIC SUBSTANCE. STUDENTS SHOULD WEAR PROTECTIVE GLOVES AND AVOID DIRECTLY TOUCHING AND BREATHING THE FUMES.**

3. Examine samples of feather, leather and fur with a hand lens. Sketch what you see. Dip each one in the second bowl of plain water for one or two minutes, and examine again with a hand lens. Sketch and compare to the original observations. Place each sample in cooking oil for one or two minutes, and then examine with a hand lens, sketch and compare with other sketches. Try to clean each sample dipped in oil with plain water. Record what happens to each sample. **(DON'T CREATE YOUR OWN OIL SPILL BY LETTING THE OILY WATER GO DOWN THE DRAIN).**

4. Now have the students try to clean their samples in each of the detergent solutions. Try one sample per detergent. Ask the students to write down which detergent (solution #1, #2, or #3) worked the best. Let the students compare their results and record them on a data sheet or in their journal. Discuss changes in the samples after exposure to oil and then to detergents. What effect could these changes have on normal bird or animal activity?

5. Reveal the names of the detergents and show the students the containers they were in. Which detergent was the most effective? The Bird and Otter Rescue Centers in Alaska used Dawn Detergent. How do their results compare with yours? Explain that detergents are like dispersants. They break up the oil, but the hydrocarbons in a natural ecosystem would still be in the water column and would end up in the sediments. The toxic compounds released in the water column also have the potential to affect the minute plants and animals involved in food chains which lead to fish, birds and mammals.

6. POUR YOUR REMAINING OIL BACK IN ITS ORIGINAL CONTAINER USING A FUNNEL. SAVE YOUR OIL AND WATER MIXTURES FOR THE NEXT ACTIVITY—CLEAN-UP TECHNOLOGY. (BE

CRITTER CLEAN-UP

SURE TO KEEP THE OIL/WATER MIXTURE SEPARATE FROM THE OIL/WATER/DETERGENT MIXTURES.) DISPOSE OF OILY WASTES PROPERLY SO THEY DO NOT END UP IN THE LAND-FILL AND THE WATER. (See the directions in the introduction for proper disposal recommendations).

7. Discuss what could happen to a bird, an otter or a seal in an oil spill. Why are feathers, fur and leather important to wildlife? How do birds clean their feathers? What might happen if a bird ingested the oil? How do sea otters clean their fur? What would happen if a sea otter ingested oil? Discuss possible impacts on other wildlife species, on humans, and on the environment. What trade-offs are involved? What are other examples of human-caused pollutants that can have negative consequences for wildlife, people and the environment? What can you do to help with these problems?

8. Discuss how people try to save birds caught in oil spills. Does handling birds cause problems? (stress) Could detergents be harmful to the birds? What ingredients are listed on the package? Are they safe for animals? Marine birds need waterproof feathers. Would their feathers be waterproof after cleaning? Is cleaning the bird the best option? What about triage -the intentional (but painless) killing of animals? What are some factors that may need to be taken into account before deciding the best action for animals caught in an oil spill? Answer these same questions for other animals.

9. To evaluate students' understanding have them answer these questions in their journals:

- a. How could an oil spill affect the success of birds nesting near the water?
- b. Describe some possible effects of oil on a feather.
- c. Explain why the effects of oil are different from those of water.
- d. Describe some possible negative effects of three other human-caused pollutants on people, wildlife and the environment.

EXTENSIONS:

1. Science/language arts. Investigate why and where oil spills occur. What kinds of animals are found in these places? What kinds of rescue and cleaning techniques have been tried and how successful have they been? What were the results of the Alaskan Bird and Otter Rescue Centers after the Exxon spill?

2. Science/language arts. Ask each student to write a report, summarizing the findings of the experiment as well as making recommendations. Refer to the Wildlife Rescue activity of this curriculum.

3. Choose references from the appendices or conduct a literature search through your local library on impacts of oil spills on wildlife. Research a species of wildlife and determine the impacts of the *Exxon Valdez* oil spill. Report on scientific research conducted and the findings.

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CLEAN-UP TECHNOLOGY

Adapted from Alaska Science and Marine Science Project: FOR SEA Poulsbo, Washington 98370.

Revised by Beth Trowbridge, PWS Science Center, 1995 with background information provided by Bruce McKenzie, Alaska Clean Seas.

SUBJECTS: Science

DURATION: 1 period

OBJECTIVE: Students will: 1) evaluate various clean-up techniques and their efficiencies; 2) demonstrate use of various clean-up techniques for an experimental oil spill; 3) discuss the causes and effects of ocean pollution.

BACKGROUND: Many different clean-up techniques were used following the *Exxon Valdez* oil spill. Below a brief discussion of each technique is given. For more detailed information on various clean-up techniques and their merits, see references cited in the appendices.

There are basically four ways to clean-up oil spills. These are: mechanical containment and recovery, dispersants, shoreline clean-up, and burning.

Mechanical skimming of oil is considered the response method least harmful to the environment. It requires large quantities of equipment and personnel. It is a multistage process that can be time consuming and has several potential bottlenecks in which the system can break down. First you need to contain the oil; then you need to recover it, store it temporarily, treat it (remove the water) and then dispose of it. In each stage you handle the oil; equipment and personnel are needed. The operation will be hampered if, in any stage, the system breaks down. Equipment used can include skimmers, booms, suctioning devices and buckets.

Chemical Dispersants are used to break oil into small droplets in the upper part of the water column. They cause a chemical change to occur in the oil that allows it to disperse into the water column. Some studies show that dispersants speed up natural dispersion, degradation and evaporation. Other studies show dispersants to be highly toxic and ineffective in cold waters. To be effective, dispersants must be applied soon after a spill, since weathered oils are hard to disperse. Mixing energy from wind and waves is also needed. Pre-approval is required from the government before dispersants can be applied on a spill.

MATERIALS:

- *Salad oil
 - *Paprika
 - *Motor oil
- *These items can be replaced with the oiled water from previous experiments if desired

Eye dropper

Clean-up materials:

- Nylon net
- Nylon hose
- Styrofoam
- String
- Straw
- Detergents
- Popsicle sticks
- Seaweed/pondweed
- Absorbant pads
- Fan (optional)
- Worksheet:
Clean-up Data Sheet

CLEAN-UP TECHNOLOGY

Shoreline Clean-up involves the physical removal of oil from beaches. This is the most labor and equipment intensive response method and techniques must be chosen carefully. Removal of oiled sediments can sometimes create environmental problems such as beach erosion. Running heavy equipment on shorelines can sometimes do more damage than the oil. A variety of shoreline clean-up methods are available. The one used depends on the beach type, its location, the type of oil and the equipment and manpower available.

In-situ Burning creates a temporary air pollution problem that may pose a risk to people exposed to the smoke. Unwanted fires can also happen. Burning works best on fresher oil and specialized equipment and trained personnel are necessary. Controversy exists about this method's effectiveness and hazards.

Another response, not always recognized, is "no response." After the *Exxon Valdez* spill, NOAA studied sites that were not cleaned up and documented considerable survival and recovery of marine life.

Citizen clean-up programs after the *Exxon Valdez* oil spill involved many different techniques such as oiled seaweed pickup on the beaches. Seaweed is a natural oil collector so the more picked up meant less oil that spread to other bays and estuaries. Pom-poms made of oil-absorbant material were also used to pick up oil. Bioremediation, the use of fertilizer to increase the populations of oil eating bacteria, was another technique that was tried. Also, a rock washing program was developed where rocks were cleaned by tying them up in specially designed bags so the ocean's tidal action could wash them. Oil absorbant pads were used to wipe off rocks individually and for general clean-up, i.e. boots of oil spill workers.

Discuss with students how they would determine if the area affected by the spill was clean enough. How clean is clean enough? This is an area of debate among scientists and agency representatives who disagree about what "clean" really is.

PROCEDURE:

1. Introduce the lesson to students by explaining to students that they will investigate various clean-up products and methods, such as: skimmers and booms, dispersants (detergents), oiled seaweed or pom-poms, absorbant pads, suctioning (eyedropper), and collecting with buckets. Discuss with them creative solutions to cleaning up oil spills. Allow them to list alternative methods and experiment with them during the following exercise. The problems they will face will be similar to those that occurred in Prince William Sound in 1989.

2. Place a tablespoon of salad oil (mix with paprika if desired) in the water. First try containing the oil spill with booms. Decide on one material to use as a boom, and use it to contain the oil spill. How well does it work? What if there was rough weather? Simulate rough weather by blowing over the surface, or fanning the surface with a card. Have students record their results on the Clean-up Data Sheet.

CLEAN-UP TECHNOLOGY

3. Now use at least two other techniques for cleaning up the oil spill such as dispersing the oil and absorbing the oil with various materials. Use a watch to determine the amount of time it takes to clean up the spill. Record your results on the data sheet.

4. Now perform the same procedures using a heavier oil such as motor oil. **YOU CAN USE THE OILED WATER FROM YOUR PREVIOUS EXPERIMENTS.** Are there differences in the amount of time or materials necessary to clean up heavy oil?

5. One of the conditions that hampered the Prince William Sound oil spill clean-up was rough weather. Set up the experiment again, and simulate rough weather by blowing over the surface or by moving a card through the water. Repeat two of the techniques with heavy oil and rough water. Record the data.

Encourage students to experiment with various materials or to design their own clean-up device or technique.

6. Clean up the lab stations and **DISPOSE OF THE OIL AND OILY WASTES PROPERLY** (See instructions in the curriculum introduction). Now discuss, or have students answer in their journals, the following questions:

- A. With which method were you able to most rapidly clean up the oil spill?
- B. Ocean spills are often contained by placing booms, or barriers around the oil. What types of booms did you use to contain your oil spill? How well did they work in rough weather?
- C. Which of the techniques removed oil by absorption?
- D. Some people say that absorption techniques simply move the oil spill from the water to the land. What do you suppose they mean?
- E. What effect did detergent have on your oil spill?
- F. Did the detergent make your clean-up technique more effective or less effective? Please explain.
- G. Detergents are useful in cleaning because they kill bacteria. Does the fact that detergents kill living things present any problems when detergents are used to clean up oil spills? Please explain.
- H. Fire is another technique often used to remove oil spills. The oil spill is ignited and allowed to burn. Unfortunately, oil will only burn when it is fresh because the volatile aromatics will evaporate quickly. Where does the oil from the water go when it is burned? What kind of problems might this cause?

7. Have students use their journals to summarize, in one or two paragraphs, what they have learned about oil spill clean-up. Be sure to include environmental factors which can influence clean-up efforts and oil composition. In a third paragraph, have them state their opinion of the best techniques to clean up an oil spill.

CLEAN-UP TECHNOLOGY

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CLEAN-UP DATA SHEET

Name: _____

Date: _____

	Material	Time to Clean Up Spill	Estimate % of oil cleaned up	Comments: (e.g. messy, left with oily straw, etc.)
Light Oil				
Heavy Oil				
Heavy Oil and Rough Water				
Heavy Oil plus Detergent				

Reprinted from: Alaska Science, Centralized Correspondence Study, Alaska Dept. of Education.

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MAPPING THE SPILL

BY: Dr. John Morack, Physics Dept., Univ. of Alaska, Fairbanks.

Revised by Beth Trowbridge, PWS Science Center, 1995

SUBJECTS: Physical science, geography, mathematics

DURATION: 1-2 periods

OBJECTIVES: Students will 1) demonstrate an understanding of a scale drawing or a map; 2) demonstrate an understanding of the concept of area by using proper measurement techniques; 3) explore the uncertainties associated with experimental data and develop possible solutions.

BACKGROUND: The maps provided were produced from three different overflights: Exxon, DEC and NOAA. This is a good example of how data collected can vary depending on the researcher. These overflight maps are from the same day yet they show varying amounts of oil in Prince William Sound.

PROCEDURE:

1. Begin by showing slides or photographs of an oil slick. Discuss what students think they are seeing and what they actually are seeing. Note the differences in observations and conclusions drawn by the students. Compare this to the differences in maps produced by the agencies in this lesson. Discuss prior knowledge of oil spills and how they spread. What do they think will influence spreading? What might be an obstacle to mapping a spill?

MATERIALS:

- Overflight maps: see Appendix C
- Grid reproduced on clear plastic or overhead
- Alaska map or globe
- Oil spill maps
- Slides or photographs of an oil slick

2. Take one of the overflight maps and show the students on an Alaskan map or a globe what this enlarged map represents. Discuss the meaning of drawing the maps to different "scales." Possible discussion questions:

- a.) Why do we make maps in different sizes?
- b.) How can we take a part of the surface of a globe and draw it on a flat surface?
- c.) What does the label 147° on the map mean?

3. Introduce the operational definition of an area:

- a.) Define a standard area (one of the squares on the plastic grid). In this case the standard is quantified as 1 square mile. This standard is arbitrary and you could choose some other grid if you wish.
- b.) Place the grid over the unknown area and count the squares (estimating the fractions of squares) that cover the area. This sum is what we call the area and it should

MAPPING THE SPILL

have the units of square miles (or other quantity if you use another grid).

4. Have all the students (or groups of students) perform this activity on one of the oil spill maps to determine the size of the spill on the afternoon of March 26, 1989. Possible discussion questions:

a.) Why can't we use $L \times W$ to determine the area in this case? (The reason $L \times W$ cannot be used in this situation is that the oil spill has too many fingers and extensions that don't fit into a simple $L \times W$ equation).

b.) What would one have to do to measure the area on a map of different scale? (Note: different size is different than different scale).

5. Make a histogram of the students' area measurements of the oil spill for each of the three oil spill maps. Along the horizontal axis you should plot a linear scale that encompasses all the area values that the students have measured. Divide this scale up into approximately eight equal segments. Each segment will encompass a range of area values. Determine the number of measurements that fall in each range and plot as a bar graph. For example, if three measurements fall in one of the ranges, then you should plot a bar of height 3 for that segment. The bar chart shows that you get a spread in the data when you make a measurement. Determine the average of the data values and indicate it on the bar graph at the proper place. The measured value for each area should be the average value calculated (or estimated from the bar graph) along with plus and minus values which are large enough to include all of the actual data. The plus and minus values indicate the maximum uncertainties in the data.

6. Using the wind data provided, construct a time history of the slick and what winds did to it. Ocean current information is not available.

7. Use the following discussion questions to evaluate student understanding of the lesson's objectives:

a.) Where does the average value fit on each bar graph? Why is it near the middle of the data?

b.) Why are the area values for each oil spill map so different when the maps were drawn at approximately the same time?

c.) What kind of conclusions can one draw concerning the method used to map the spill? How might this procedure be improved in the future? How might the class insure that different techniques are used in future spills?

EXTENSION:

1. Invite a government or industry person to the class to discuss how the oil spill was tracked and mapped.

CHEMICALS IN OIL

BY: Jim Lokken

SUBJECT: Chemistry

DURATION: 1 period

OBJECTIVE: Students will use the Merck Index to identify chemicals found in crude oil.

BACKGROUND: Chemicals are everywhere. They are in the smallest villages, they are used in many jobs and are dumped or left lying around. Many cause no health problems. Others are poisonous or carcinogenic (cause cancer) or are very flammable or corrosive.

If chemicals are around you, you need to find out about their dangers. Use the MERCK INDEX, the chemist's dictionary which can be found in libraries across Alaska.

PROCEDURE:

1. North Slope crude oil contains hundreds of different chemicals in each fraction. To become familiar with the Merck Index and the toxicity of crude oil, students will look up the following chemicals found in oil and write down a description of the dangers associated with them.

MATERIALS: <input type="checkbox"/> Merck Index

hexane _____

naphthalene _____

toulene _____

benzene _____

ethylbenzene _____

xylene _____

2. Discuss the dangers of these chemicals with the students. Which is the most dangerous? _____

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THE CHEMISTRY OF OIL

BY: Jim Lokken

SUBJECT: Organic chemistry

DURATION: 1 - 2 periods

OBJECTIVES: Students will fractionally distill North Slope crude oil into its components.

BACKGROUND: Crude petroleum is an exceedingly complex mixture consisting primarily of saturated hydrocarbons of the paraffin or methane series. The separation of components from such a mixture by the process of fractional distillation depends upon the fact that the compounds present in crude petroleum boil at different temperatures (have different boiling points, BP). Such a distillation is not efficient enough to permit the separation of individual pure compounds but yields "fractions" or mixtures of compounds having similar boiling temperatures. This experiment demonstrates what occurs in an oil refinery. Refer to "Where Does That Oil Go?" worksheet in the grades 4-6 curriculum.

MATERIALS:

- Distillation apparatus
- Data Tabulation sheet
- Identification of Petroleum Fractions Worksheet
- Fractional Distillation of Crude Petroleum Worksheet
- Crude oil sample

PROCEDURE:

1. Set up the distillation apparatus from which fractions can be taken according to observed temperature changes.
2. Record the variety of physical data that is available to you using the tabulation chart found at end of lesson.
 - 1.) Range of temperature in which fraction is taken;
 - 2.) Volume and weight of fraction, from which density can be calculated;
 - 3.) Time required for fixed volume of fraction to flow from pipet of specified volume: measure of viscosity;
 - 4.) Color of fractions and odor;
 - 5.) Qualitative observations of changing refractive index.
3. Assign names to the respective fractions, according to their probable uses and in terms of their physical properties.
4. Do calculations and answer questions on worksheet.

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IDENTIFICATION OF PETROLEUM FRACTIONS, TYPICALLY ALKANES SEPARATED FROM CRUDE OIL

Name	Average C Composition	Boiling Range °C	Approx. % of Total Crude
Light gases	~C ₂	~0°	Small
Petroleum "ether" Naphtha ("white gas")	~C ₅	~25°	
Gasoline	~C ₈	50-100°	~20%
Kerosene (Jet fuel)	~C ₁₂	150-200°	~20%
Heating oil and Diesel Fuel	~C ₁₅	200-250°	~25%
Lubricating oil and mineral oil	~C ₃₀	250-350°	~10%
Residuum	~C _{50 and up}	350°	25%

*Although the boiling point of pure ethane is -90°, quantities of C₁ -C₄ gases may be held in solution in petroleum at higher temperatures.

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TABULATE DATA

Volume of sample distilled _____ ml
 Weight of sample distilled _____ g
 Density of crude oil _____

Fraction Number	Boiling Range		Color	Commercial Name
1.	_____	C	_____	_____
2.	_____	C	_____	_____
3.	_____	C	_____	_____
4.	_____	C	_____	_____
5.	_____	C	_____	_____

Fraction Number	Weight	Volume	Density	% of sample by weight		Viscosity
1.	_____ g.	_____ cc.	_____ g./cc.	_____ %	_____ %	_____ sec.
2.	_____ g.	_____ cc.	_____ g./cc.	_____ %	_____ %	_____ sec.
3.	_____ g.	_____ cc.	_____ g./cc.	_____ %	_____ %	_____ sec.
4.	_____ g.	_____ cc.	_____ g./cc.	_____ %	_____ %	_____ sec.
5.	_____ g.	_____ cc.	_____ g./cc.	_____ %	_____ %	_____ sec.

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FRACTIONAL DISTILLATION OF CRUDE PETROLEUM WORKSHEET

CALCULATIONS:

1. Calculate density for the crude oil and each of its fractions.
2. Calculate by weight the percent represented by each fraction relative to the crude oil sample distilled.

QUESTIONS:

1. What requirement must be met if two compounds are to be separated by the process of fractional distillation? _____

2. Judging from the results of the laboratory demonstration, what general relationship exists between molecular weight and volatility? _____

3. From everyday experience, cite evidence tending to show that the viscosity of a liquid changes with change in temperature. _____

4. Among the products of the distillation of crude petroleum, is there any apparent relationship between boiling range and viscosity? Explain. _____

5. By what means may high-boiling fractions such as fuel-oil or paraffin be converted into gasoline? Explain briefly. _____

6. What evidence is there for the presence of sulfur compounds in this petroleum?

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OIL'S EFFECTS ON THE MARINE ENVIRONMENT

BY: Elizabeth Trowbridge

Revised by Beth Trowbridge, PWS Science Center, 1995

SUBJECTS: Chemistry, biology

LESSON LINKS: Chemicals in Oil; The Chemistry of Oil

DURATION: 2-3 periods

OBJECTIVES: Students will 1) demonstrate an understanding of the chemistry of oil by conducting basic experiments on different forms of oil; 2) analyze potential effects of oil on a marine environment by reviewing papers written by science experts preceding and following the *Exxon Valdez* oil spill.

BACKGROUND: Crude oils vary greatly in their properties and crude oil spills behave in different ways because of these inherent oil property variations. For examples, some crude oils tend to strongly and quickly emulsify when spilled (within a few hours), while others are slow to emulsify. Knowing whether an oil emulsifies quickly or not is very important because emulsification dramatically affects the feasibility of both dispersant-use and in-situ burning, the rate at which the spill can be skimmed, the types of skimmers that can be used and the ultimate fate of the spilled oil. Similarly, crude oils with high pour points behave very differently than otherwise similar oil that have lower pour points; the former tend to gel quickly and persist on the water surface. On the other hand, very light oils and condensate, when spilled, can evaporate and naturally disperse so quickly as to make conventional spill countermeasures unnecessary.

Note: It is strongly recommended that you precede this lesson with "Chemicals in Oil" and "The Chemistry of Oil."



MATERIALS:

Excerpts from the following article:
 "The Legacy of the Exxon Valdez"
by Dr. Riki Ott

- Oil Vocabulary List
- Journals or notebooks

OIL'S EFFECTS ON THE MARINE ENVIRONMENT

PROCEDURE:

1. Introduce the students to the background information on properties of oil. Review previous lesson results and common oil vocabulary. Hand out the vocabulary list and have students research definitions prior to reading the following articles, or have them complete the worksheet while reading the articles.
2. If you are unable to do the lessons that were recommended to precede this lesson, you may want to conduct the following lab demonstration, suggested by Bruce McKenzie, Alaska Clean Seas, to show the varying viscosity characteristics of common liquids at room temperature. A demonstration such as this will provide an excellent example of the spreading of liquids with varying viscosity on water. Listed below are a few different liquids and their viscosity levels.

Liquid	Viscosity (cP)
Water	1
Kerosene	10
SAE 10 motor oil	100
Glycerin or castor oil	1,000
Corn syrup	10,000
Molasses	100,000
Peanut Butter	1,000,000

Viscosity is probably the most important oil property from the perspective of spill behavior because it is the predominant factor that:

- * controls oil spreading (more viscous oils spread more slowly)
- * controls natural and chemical dispersion (more viscous oils are harder to disperse)
- * controls emulsification (more viscous oils form more stable emulsions)
- * controls recovery and transfer operations (more viscous oils are generally harder to skim and more difficult to pump)

OIL'S EFFECTS ON THE MARINE ENVIRONMENT

3. Have students outline an article in their notebooks or journals, filling in any missing pieces.
4. Ask each student to come up with a definition or sentence describing a vocabulary word on the list. Secretly assign words to students. Collect these sentences/definitions and create a quiz or worksheet for the students.

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OIL VOCABULARY

crude oil:

hydrocarbon:

aliphatic:

aromatic:

naphthalene:

inorganic compounds:

reining:

evaporation/dissolution:

dispersion:

metabolism:

mousse:

zooplankton:

copepods:

detritus:

pelagic:

benthic:

acute exposure:

chronic exposure:

toxicology:

carcinogen:

teratogen:

mutagens:

parent compound:

metabolite:

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MODEL TANKERS

BY: Belle Mickelson and Elizabeth Trowbridge

SUBJECTS: Shop, voc. ed., math, science

DURATION: Minimum of 2 periods

OBJECTIVES: Students will be able to describe how oil is carried in tankers. Students will discuss tanker navigation and the role of tanker captains. Students will debate single versus double hulls and other safety features. Students will design and build model tankers incorporating a variety of safety features. Students will understand the connection between energy conservation and tankers.

BACKGROUND: The *Exxon Valdez* ran aground on Bligh Reef and ripped a hole in its hull renewing a controversy over the pros and cons of single vs. double hulled tankers and other safety features. The *Exxon Valdez* was a midsized tanker 987' long and 166' wide. The largest tanker in the world, the *Knock Nevis* (formerly called the *Jahre Viking* and now used as an immobile offshore platform) is 1504' long, 226' wide. "Tankers Full of Trouble," the SeattleTimes reprint, describes a voyage on the *Arco Anchorage*. This six-part special report covers tanker crews, safety features, the double-bottom debate, inspectors and investigations, tanker traffic in Washington, and what can be one to improve tanker safety. Since the *Exxon Valdez* oil spill these issues have become very important.

PROCEDURE:

1. Use the opening page of the Seattle Times reprint "Tankers Full of Trouble" to introduce the topic of tankers and tanker safety. Read the section on tanker crews. Ask the students if they know anyone who has worked on a tanker. Make a list of tanker crew and captain duties. Discuss the problem of alcoholism in the marine industry. What are the Coast Guard regulations? Why should captains want to be sure that their



The Polar Resolution, a double-hulled tanker operated by ConocoPhillips, made its first voyage into Valdez in the summer of 2002.

MATERIALS:

- "Tankers Full of Trouble" Seattle Times reprint
- Rulers
- Measuring tape
- Drafting tools
- Materials for constructing model tankers : cardboard, heavy paper, aluminum, etc.

MODEL TANKERS

crews are not drinking? (A ship is its own island - in an emergency each crew member will be needed with his/her full faculties to save the ship and/or lives.)

2. Measure the size of the *Exxon Valdez* outside your school and mark its size to show to other students and the community. Mention to students that they will be making a scale model of a tanker.

3. Discuss safety features. Oil tankers are some of our largest ships and they carry a cargo extremely hazardous to oceans, coastlines, and the people and wildlife that inhabit these waters and shores. Oil is a very valuable resource and one that all of us use daily. So how can it reach us more safely? List tanker safety features and costs described in "Tankers Full of Trouble."

4. Challenge students to design the safest tanker to transport oil. Have students draft plans for model tankers and build them.

5. Have students research the costs associated with building their tankers. Is there a design that is cheapest and safest? How do the costs compare? What might be some consequences of using the "cheapest" design if it is not necessarily the "safest" design? Can compromises be made? Are students willing to pay more for the cost of their gas and oil to cover the costs of building safer tankers? Would safety features actually cost more? Think how much Exxon spent on the oil clean-up in Alaska.

6. Have students analyze their tanker designs developed in class. What suggestions do your students have for transporting oil? Invite a marine architect, shipwright, captain, or oil industry official to visit your class and look over your plans. Then write a letter to an oil company with your suggestions.

7. Discuss the fact that by saving energy (using less oil), less tanker traffic will be required worldwide. The less oil that is carried in tankers, the less oil that will be spilled. Ask students how they could conserve energy. Mention better insulated and weather-proofed homes, more efficient engines, using less electricity, changing oil less often and recycling oil.

WILDLIFE FIELD GUIDE

BY: Elizabeth Trowbridge

SUBJECTS: Biology, art

DURATION: Minimum of 4 periods

OBJECTIVES: Students will identify several species of wildlife in southcoastal Alaskan waters impacted by the spill. Students will identify the major habitats of each species. Students will learn to identify birds, mammals and fish found in southcoastal Alaska; understand the richness of life this area holds, how all living things are interconnected by their dependence on each other; and how an oil spill can alter this dependency in life threatening ways.

BACKGROUND: Prior to March 24, 1989, southcoastal Alaska was a haven for many species of wildlife: five species of salmon, bottomfish, shellfish, marine mammals, terrestrial mammals, shorebirds, sea birds, migratory ducks and birds of prey. When the *Exxon Valdez* spilled its cargo into Prince William Sound, habitats were contaminated with crude oil, altering the life and feeding cycles of these species.

PROCEDURE:

1. Read sections of Alaska Fish and Game "Special Oil Spill Issue."
2. Brainstorm, or use bubble diagram, to find species of wildlife students are familiar with and habitats they have seen. Use this time for open discussion of experiences students have had exploring these habitats, wildlife they have seen, and what it has meant to them to see this wildlife.
3. Hand out the Word Search worksheet. Explain that several of the impacted species can be found within the puzzle. Have students initially try to find as many as they can on their own, creating their own list of species. When



MATERIALS:

- Alaska Fish and Game "Special Oil Spill Issue"
 - Paper
 - Markers/pens/pencils
 - Field guides
 - Glue/tape
 - Scissors
 - Wildlife Notebook Series (Optional)
- Worksheets:
- Land Mammals
 - Birds
 - Finfish
 - Shellfish & Intertidal Life
 - Marine Mammals
 - Wildlife Word Search
 - Vertebrate Species Potentially Impacted by the Exxon Valdez Oil Spill...

WILDLIFE FIELD GUIDE

they have “given up,” hand out the printed list of species that can be found in the puzzle. Ask them how well they did on their own. For the sake of simplicity the word search puzzle uses common general names.

4. In this next phase students will be making their own “Wildlife Field Guide to Southcoastal Alaska.” This activity can be as elaborate as you wish to make it. The main objective is to have the students identify, classify, draw, and describe the wildlife found in this area, depending on the grade level of the students. If the students are in Jr. High, hand out copies of the AK Dept. of Fish and Game Wildlife Notebook series to each student. If the students are in high school it may be more appropriate to hand out copies of common field guides such as Freshwater Fishes of Alaska, Pacific Fishes of Canada, Guide to the Birds of Alaska, A Field Guide to the Mammals, A Field Guide to the Birds of North America, and Natural History of Alaska’s Prince William Sound. Use whichever field guides are available but be sure to have one covering each of the major wildlife groups: fish, birds and mammals. If there are enough guides for each student, do this activity individually. If resources are limited, divide the class into groups. Have the students look up each species found in their puzzle. A worksheet with each of the species is included with this unit and may be used for cutting and pasting the field guide. If this is a class activity, assign each student a species to research and prepare a page for the field guide. If this is an art project, have students draw the species, making certain that major characteristics are apparent. Next to each drawing students should list the major characteristics, habitats and range of each species. Students should also list the major sources of food for each species.

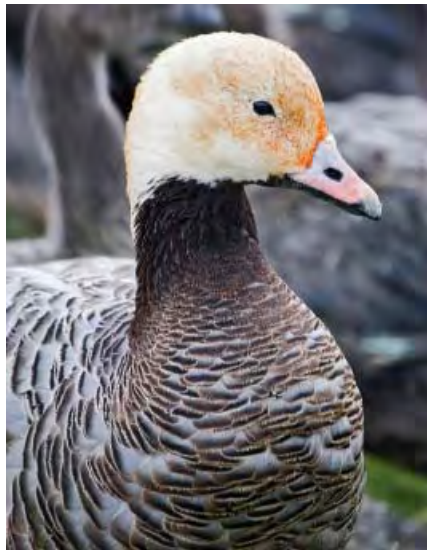
5. The “Wildlife Field Guide to Southcoastal Alaska” should be the final result of this activity. Discuss with the students how their view of southcoastal Alaska may have changed. Were there more animals and birds than they thought? Explain also that this task does not even begin to cover all the living things that are found in the Sound, this represents those vertebrate species most impacted by the *Exxon Valdez* oil spill. How long do they think it would take them to put together a comprehensive field guide to the Sound? Do they understand why there are separate field guides for each major group of wildlife? Can they think of other living things that may have been left out of their field guide?

6. As a final and evaluative activity, come up with a statement to preface their field guide (either individually or as a class) that best describes the wildlife in southcoastal Alaska.

WILDLIFE WORKSHEETS - LAND MAMMALS



WILDLIFE WORKSHEETS - BIRDS



WILDLIFE WORKSHEETS - FINFISH



WILDLIFE WORKSHEETS - SHELLFISH/INTERTIDAL LIFE



WILDLIFE WORKSHEETS - MARINE MAMMALS



WILDLIFE WORKSHEETS - WORDSEARCH

n h n r g p j z c x c b j p r u c z b b
c w c i o a k j q d x j o c g z r b v d
y k q o r m r w o s r x q d s e z w k q
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m e h y r w a m i k y b t x k c w k u o
r q s d u f h t i e e b w f f a a u q m

Look for words forward, backward, vertically, and diagonally
(words listed on next page).

WORDSEARCH SPECIES LIST

bear
canvasback
coho
cormorant
coyote
crab
eagle
falcon
fox
goldeneye
grebe
gull
halibut
kingfisher
loon
mink
murre
pintail
porcupine
puffin
raven
rockfish
sandpiper
scoter
seal
seatotter
sockeye
teal
weasel
whale
wolverine

WILDLIFE WORKSHEETS - WORDSEARCH SOLUTIONS

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+ + + C C + W H + C E + + + + + + + + +
+ + + C O R M O R A N T + + + + + + + + +
+ + + + T Y A C L N + + L + + + + + + + + +
G R E B E + O B + V + A + + + + + + + + +
S L + + R E T T O A E S + + + + + + W + +
+ O I + + + F + E S + R + + + + + H + + +
+ + C A + + + A L B K N I M B E A R + + +
+ + + K T U B I L A H L + N + L + + + + + +
+ R A V E N I P U C R O P + E + + + + + + +
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+ + + + + F A + + D K + F + + + + + + + + +
+ + + + + I + E + + C L + + I + + + + + + + +
+ + + S + + + + O + + O + + N + + + + + + +
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+ E + + + + + + + + + + + + + + + + + + +
R +

Vertebrate Species Potentially Impacted by the Exxon Valdez Oil Spill in Prince William Sound

WATER BIRDS

Common Loon
Yellow-billed Loon
Pacific Loon
Red-throated Loon
Red-necked Grebe
Horned Grebe
Black-footed Albatross
Laysan Albatross
Northern Fulmars
Pink-footed Shearwater
Sooty Shearwater
Short-tailed Shearwater
Fork-tailed Storm-Petrel
Leach's Storm-Petrel
Double-crested Cormorant
Pelagic Cormorant
Red-faced Cormorant
Great Blue Heron
Tundra Swan
Trumpeter Swan
Canada Goose
Black Brant
White-fronted Goose
Snow Goose
Mallard
Gadwall
Pintail
Green-winged Teal
American Widgeon
Shoveler
Ring-necked Duck
Canvasback Duck
Greater Scaup
Lesser Scaup
Common Goldeneye
Barrow's Goldeneye
Bufflehead
Oldsquaw
Harlequin Duck
Steller's Eider
Common Eider
King Eider
White-winged Scoter
Surf Scoter
Common Scoter
Red-breasted Merganser
Sandhill Crane
Pomarine Jaeger
Parasitic Jaeger
Long-tailed Jaeger
Glaucous Gull
Glaucous-winged Gull
Herring Gull
Mew Gull
Bonaparte's Gull
Black-legged Kittiwake
Sabine's Gull

Arctic Tern
Aleutian Tern
Common Murre
Thick-billed Murre
Pigeon Guillemot
Marbled Murrelet
Kittlitz's Murrelet
Ancient Murrelet
Parakeet Auklet
Crested Auklet
Rhinceros Auklet
Horned Puffin
Tufted Puffin
Belted Kingfisher

RAPTORS

Bald Eagle
Golden Eagle
Great-horned Owl
Short-eared Owl
Northern Harrier
Osprey
Merlin
Sharp-shinned Hawk
Red-tailed Hawk
Rough-legged Hawk
Northern Goshawk
Peregrine Falcon

PASSERINES

Northwestern Crow
Raven
Black-billed Magpie
Gray Jay
Steller's Jay
American Robin
Varied Thrush
Hermit Thrush
Water Pipit
Rusty Blackbird
Rosy Finch
Savannah Sparrow
Song Sparrow
Lapland Longspur
Snow Bunting

SHOREBIRDS

Black Oystercatcher
Semipalmated Plover
Lesser Golden-Plover
Black-bellied Plover
Surfbird
Ruddy Turnstone
Black Turnstone
Common Snipe
Whimbrel
Bristle-thighed Curlew

Spotted Sandpiper
Solitary Sandpiper
Wandering Tattler
Greater Yellowlegs
Lesser Yellowlegs
Knot
Rock Sandpiper
Pectoral Sandpiper
Baird's Sandpiper
Least Sandpiper
Dunlin
Short-billed Dowitcher
Long-billed Dowitcher
Semipalmated Sandpiper
Western Sandpiper
Bar-tailed Godwit
Hudsonian Godwit
Sanderling
Red Phalarope
Red-necked Phalarope

MARINE MAMMALS

Sea otter
Steller's sea lion
Harbor seal
Dall porpoise
Harbor porpoise
Killer whale
Gray whale
Minke whale
Belukha whale
Fin whale
Humpback whale

TERRESTRIAL MAMMALS

Mink
River otter
Deer
Black Bear
Brown Bear
Coyote
Red Fox
Least weasel
Wolf
Lynx
Beaver
Muskrat

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INTERTIDAL ZONES

Adapted from Alaska Sea Week Curriculum Vol. VI.

SUBJECTS: Biology, science, language arts

DURATION: 1 period

OBJECTIVES: Students will identify characteristics of intertidal zones. Students will identify invertebrates found in intertidal zones in Prince William Sound. Students will demonstrate an understanding of the effects of oil on intertidal invertebrates.

BACKGROUND: Intertidal invertebrates were heavily impacted by Exxon Valdez oil in the water because they were inundated by oil during each tidal cycle. Most intertidal creatures are planktonic feeders so they ingest spilled oil with every tide. The results are death, deformities and lack of turgidity. The oil spill clean-up, with its thousands of workers trampling over barnacles and mussels, also impacted heavily. The pressurized hot water clean-up technique used not only washed off oil, it washed off and killed all intertidal life. Some scientists argued that getting rid of the oil was more important because it avoided long-term toxicity; other scientists felt that intertidal life could have recovered much more rapidly on its own. Use the Alaska Sea Week Curriculum Guide Series, Under Alaskan Seas by Lou and Nancy Barr, and Natural History of Alaska's Prince William Sound by Pete Mickelson for additional background information on intertidal life (available from libraries).



MATERIALS:

- Paper
 - Pens
 - Pencils
 - Posterboard or blackboard
- Worksheet:
- Intertidal Zones

PROCEDURES:

1. Review intertidal zones. Ask students to predict invertebrates they would find at each intertidal zone.
2. Hand out the Intertidal Zones worksheet. Discuss each zone, identifying invertebrates and their habitats. Identify predator/prey relationships. Diagram the food web on posterboard or blackboard. Divide the class into pairs and have students answer the questions on the worksheet.

3. Mount poems from the worksheets, with illustrations, on bulletin boards. Use the students' poems to evaluate their understanding of intertidal invertebrates and the effects of oil on this habitat.

INTERTIDAL ZONES WORKSHEET

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

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

The Highest Fringe

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

The Middle Zone

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

The Lowest Zone

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

INTERTIDAL ZONES WORKSHEET

Answer these Questions:

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

a. _____

b. _____

c. _____

d. _____

e. _____

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

a. _____

b. _____

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

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

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

a. _____

b. _____

INTERTIDAL ZONES WORKSHEET

c. _____

d. _____

e. _____

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

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

7. Which invertebrates might be impacted?

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

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

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WILDLIFE RESCUE

BY: Elizabeth Trowbridge

SUBJECTS: Biology, art

DURATION: Minimum of 2 periods

OBJECTIVES: Students will identify major habitats of southcoastal Alaska and their inhabitants. Students will identify wildlife impacted, directly and indirectly, by the oil spill. Students will devise clean-up and rescue procedures for impacted wildlife and habitat.

PROCEDURE:

1. Read Alaska Fish and Game "Special Oil Spill Issue" and National Geographic articles on wildlife and rescue operations in southcoastal Alaska. Review "Field Guide to Southcoastal Alaska" and, as a class, identify the major habitats found in southcoastal Alaska and the characteristics of each.

2. On map provided, have each student place at least three species of wildlife in each habitat. This can be done by either drawing the wildlife or cutting and pasting from the wildlife worksheets. This can also be done as a class activity by making the map into a mural or bulletin board. Have each student place at least one species on the map. After the maps are completed ask the students how they think these species relate to each other. Try to identify obvious food webs.

3. Hand out the Wildlife and Oil worksheet. Then complete the Oil in the Food Web worksheet and discuss results as a class.

4. Using oil spill overlays, trace the development of the oil spill on the map. After each day/week observe how much area the spill is covering and the wildlife the oil has covered. Use a large pad of paper to trace the oil spill's movement and impact on wildlife. Discuss why these animals have been impacted and what characteristics they have that may have caused them to live



MATERIALS:

- Alaska Fish and Game "Special Oil Spill Issue"
- National Geographic January 1990
- "The Otter Ward" from Hard Aground
- "Otter Rescue Questioned" Field Guide to Southcoastal Alaska
- Map of southcoastal Alaska
- Oil spill overlay
- Large pad of paper
- Markers
- Worksheets:
 - Oil in the Food Web
 - Wildlife and Oil
 - Wildlife Rescue Information

WILDLIFE RESCUE

or die because of the oil. What animals feed upon them, what animals do they feed upon? (Predator/prey relationships)

5. Do the Wildlife and Oil worksheet. This activity will demonstrate the properties of oil in the water and on wildlife. Use the results from the Critter Clean-Up experiments to analyze wildlife rescue techniques.

6. What are you going to do? Have the class brainstorm ideas for clean-up and rescue of habitat and wildlife. Read “The Trauma of Being Cleaned” and “Otter Rescue Questioned” articles. Divide the class into small groups. Each group should pick one idea or method for rescue, protection and clean-up of habitat and wildlife. Use the Wildlife Rescue Information worksheet provided as an outline for considerations that must be taken into account (cost, logistics, weather, human impact, stress, etc.). Have each group present their plan of attack. Vote, as a class, on the most viable solution to the problem.

7. Have students do a fast write in their journals about their impressions of the clean-up, protection and rescue process. What were their frustrations in coming up with a solution? What are their feelings about southcoastal Alaska now?

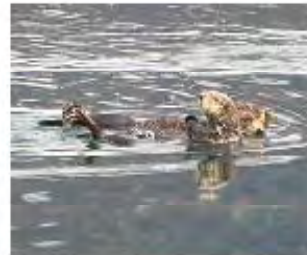
EXTENSIONS:

1. Have students assume the point of view of a gull, sea otter or land mammal and write a story about the trauma of being cleaned.

Oil on beaches damages shoreline life. Oil seeps downward into sand and remains there

OIL IN THE FOOD WEB

All animals and plants must have food to survive. Our coastal waters are particularly rich in food resources. See if you can figure out who eats who in this picture. Draw arrows from the predators to the prey. What runs this whole system?



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WILDLIFE RESCUE INFORMATION WORKSHEET

Take all of these factors into consideration as you develop a strategy for wildlife rescue operations. Be prepared to defend your rationale.

| | | |
|--|------------------------|------------------------|
| <p>COST
 What will be the cost of rescue operations? Facilities? Staff? Rehabilitation and relocation? (It cost \$89,000 to rehabilitate one sea otter after the Exxon Valdez spill)</p> | upper limit | lower limit |
| <p>LOGISTICS
 Where will the facilities be located? What buildings could be used? Whose boats? Collection method?
 Recruitment and training of staff?</p> | 1 st choice | 2 nd choice |
| | 1 st method | 2 nd method |
| <p>WEATHER
 What kind of weather might your crews encounter? How would this affect your recovery efforts?</p> | acceptable | unacceptable |
| <p>STRESS AND HUMAN IMPACT
 Is it better to leave the impacted animals to fend for themselves or to capture them and risk having them die from stress or disease? For many wild animals, especially sea otters, the trauma of human impact is often greater than most environmental or natural impacts.</p> | negative effects | positive effects |

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WILDLIFE AND OIL WORKSHEET

for years. Rocky shorelines can clean themselves naturally through wave action, but bays, estuaries and marshes have few waves. Oil spills in such areas are very damaging because wetlands are the nursery grounds for fish, birds and shellfish.

Oil causes serious harm to birds by coating their feathers. An oily bird does not float, and it has no insulation against temperature changes. Also, birds poison themselves by eating the oil that coats them.

Oil can smother communities of animals that live on the sea floor. This really affects clams, mussels, shrimp and crabs important to the shellfish industry. Most of these areas will eventually become settled again, but some organisms, like mussels, cannot survive in an oiled area.

Adult fish are not affected by oil pollution as much as other organisms. A massive spill can kill large numbers of fish, but, ordinarily, adult fish are able to escape injury from minor accidents. Smolt and eggs are extremely vulnerable to oil spills, however.

Marine mammals, such as whales, sometimes swim away from oil spills. But the oil affects them internally as they breathe its toxic fumes. Sea otters die when their fur becomes matted; they do not have any protection from the cold ocean water.

Different petroleum products have different affects on organisms. Diesel or heating oils are the most poisonous, while heavy crude and fuel oils are the worst for smothering animals.

Now, answer these questions:

1. Describe a kind of oil spill that could kill large numbers of adult fish, smolt, or eggs.

2. What kinds of petroleum products have the most undesirable effects?

3. How do these affect the organisms?

WILDLIFE AND OIL WORKSHEET

4. Are all areas of the coastline affected in the same way by oil pollution?
If not, explain these differences.

5. Success in cleaning up an oil spill depends upon rapid action by the spiller and by federal, state and local agencies. When a spill occurs, it is reported to the U.S. Coast Guard. To be effective, containment must be done as soon as a spill is detected. In the case of the Exxon Valdez, Exxon headed up the clean-up efforts with suggestions from the Coast Guard and the State of Alaska. Unfortunately, the spill was not contained immediately through the use of booms and mechanical skimmers-so the oil spread over 1,000 miles.

Write a story about what you would do to protect the wildlife if you were in charge of cleaning up a spill.

RESEARCH—The Sea Otter Project

ADAPTED FROM: FOR SEA and the Alaska Sea Week Curriculum Guide by Elizabeth Trowbridge

SUBJECTS: Science

DURATION: Minimum of 3 periods

OBJECTIVE: Students will demonstrate birth and death rates and the difficulties of estimating sea otter populations.

BACKGROUND: Read Alaska Fish and Game "Special Oil Spill Issue" article on sea otters. Xerox article for each student or read as a class. Sea otters can be found abundantly in the waters of Prince William Sound and the Gulf of Alaska. Sea otters were exploited to the verge of extinction in the late 1800s and were granted protection in the early 1900s. Populations of sea otters can be found in many areas of Alaska now, including those areas affected by the *Exxon Valdez* oil spill.

Sea otters feed primarily on clams, crabs and octopus. They have big appetites, eating 23-37% of their body weight daily. Total population numbers vary but a pre-spill estimate for Prince William Sound is 8,000-12,000, with somewhat fewer than half of them in the heavily oiled west side of the sound.

Sea otters are particularly vulnerable to oil contamination because they lack substantial subcutaneous fat and depend upon maintaining a layer of air trapped within their fur for protection against cold. Most of the sea otters that died from the spill died from hypothermia. Many sea otters also died from breathing and ingesting the most volatile and toxic fractions of thick, unweathered crude oil. Sea otters ingested the highly toxic crude oil from grooming, a necessary and continual procedure. Many of the sea otters that died were not even recovered. The high mortality rate in the first weeks puzzled rehabilitation center workers until necropsies revealed the extent of internal damage the otters suffered. There was evidence of severe damage



MATERIALS:

- Alaska Fish and Game "Special Oil Spill Issue"
- Two (2) one-quart jars of dry kidney or pinto beans
- Cardboard box about 12"x14"x2"
- Acetate about 3"x5"
- Tape
- Overhead projector

RESEARCH—The Sea Otter Project

to the otters' livers, kidneys, and lungs, presumably from ingestion during grooming, from absorption through the skin, and from the toxic effects of breathing volatile hydrocarbons such as benzene and toluene.

Scientists do not agree on the population of the sea otters in Prince William Sound. It is difficult to collect accurate data on wildlife populations. Various techniques can be used but each has its shortcomings. The following activities are designed to help the students gain an understanding of the difficulties scientists face when having to count wildlife. This can be compounded when the species migrates. Birth and death rates are also crucial pieces of information that help scientists understand the strengths and weaknesses of a population.

PROCEDURE:

1. Before class, make a counting box out of a two-inch-deep cardboard box (or two lids). Cut out a "window" in the top and the bottom and tape a three-by-five inch piece of acetate on it. Now put a number of beans in the box.
2. Begin with a jar of beans which will be representative of the sea otter population. Spill the jar of beans onto the floor and ask the students how they would count the population of sea otters. Discuss various techniques such as flying over otters, boating, radio transmitting, etc. Discuss the advantages and disadvantages of each. What are some of the difficulties they might encounter? (weather, movement, feeding patterns, not being able to tell the difference between specific animals, etc.).
3. Do bean activity. Show the students the counting box (ocean), with beans representing sea otters. Place the box on the overhead projector. Shake the box around vigorously so the beans move before the students have time to count those appearing in the window. On the basis of the beans they see, can the students estimate the total number? Take their guesses and ask what they are based on. Now try a different number of beans, either a great deal more or a great deal less, and repeat the estimations.

Based on this exercise, what does the class think are some of the problems in trying to count sea otter populations? (The otters move around, you can't tell if you've counted them before or not, they live in areas that we can't always watch, etc.).

4. Use beans, once again, to get across the effect of birth and death rates on population growth. Place two one-quart jars at the front of the classroom and divide the students into two groups. Students in one group will each add two beans to their jar, and students in the other group will add three beans at a time to their jar, to represent two different birth rates. Compare how fast the jars fill up. Now demonstrate birth and death rates. Start with both jars full. Have each group add two beans at a time to their jars, but have one group take away one and the other group take away three to represent two different death rates. What eventually happens to the three-bean group? This is an extremely simplistic model, but will show the effect of high death rates on a population, as occurred

RESEARCH—The Sea Otter Project

with the oil spill on the sea otter population. Remind students that sea otters have only 1 young per year. Explain that sea otter researchers use radio transmitters plus boat and plane counts.

EXTENSIONS:

1. Science: You have just been hired by the Fish and Wildlife Service as a marine mammal biologist. Next summer you will be conducting research on the sea otter population in Prince William Sound. Your project has these objectives: 1) Compare both short and long term changes in population size based on historic and recent survey data, and intensive surveys of specific regions before and after oiling.

- 2 Determine post spill distribution of sea otters in Prince William Sound and examine the pattern of recovery. Design your research project. What methods will you use to determine population size? How will you determine changes in population? What factors will you have to take into account?

3. Science/language arts: Research and report on other wildlife research projects being conducted as a result of the oil spill. What methods are being used? Can you identify the strengths and weaknesses in the design of the projects?

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FIELD TRIP TO THE BEACH

Adapted from: Alaska Sea Week Curriculum, Vol. VI, activity by Jim and Mary Lou King.

SUBJECTS: Math, science, language arts, art, social studies

DURATION: Minimum of 2 days.

OBJECTIVES: Students will conduct a random sample and a systematic sample using a transect. Students will demonstrate an understanding of the importance of sampling as a gauge of change. Students will observe the affects of garbage and waste pollution on the beach. Students will use communicative skills to conduct interviews and present findings.

BACKGROUND: This beach activity will serve as a catalyst for many follow-up activities and discussions. It is very important for students to gain first-hand knowledge of the resources and the impacts of humans. Understanding the difficulties of gauging populations and monitoring change will help the students evaluate the roles of local scientists and the impacts of pollution and development.

Do you ever wonder when you hear a large figure such as the total of ducks in North America, trees in the National Forest, or people who watch a certain television program, how such high numbers can possibly be counted? Often this is accomplished by a process called sampling—taking an exact count in a small area and then multiplying to obtain an estimate for the total area.

Biological sampling is sometimes done by taking counts in randomly selected plots. Coat hangers pulled into squares are a good device for marking plot boundaries. Counts are taken inside the plots and then used to estimate the number of small animals per acre on a rocky beach, the number of flowers or berries on an



MATERIALS:

- One coat hanger for every two students
- Yardstick
- 100 ft. lengths of 1/4" rope or heavy twine (for the transect method)
- Wooden stakes
- Felt-tip markers
- Hammer (or rock)
- Adhesive tape
- Small rulers
- Paper
- Pencils
- String
- Pocket notebook for each student
- Clipboard
- Field identification guides
- Camera and film (optional)

FIELD TRIP TO THE BEACH

acre of tundra, etc. This method will work for anything that is fairly evenly distributed over a large area and small enough to be found inside coat hanger plots.

Sampling is very useful for gauging changes taking place over a period of time. One may wish to measure changes resulting from natural causes: earthquakes, storm surges, shifting currents, the seasons, etc. Cycles of succession—lakes that eventually fill in to become marshes and later dry land, or meadows that gradually turn into forests—can be best understood by studying changes in animal and plant life over a period of many years.

One may also study changes caused by human activities: the construction of a boat harbor or subdivision; the building of a road or pipeline; a dredging operation, or an oil spill. Ocean pollution is a serious threat to the earth. Two forms of pollution are plastics, which harm wildlife and biodegrade very slowly, and oil, which is poisonous. Scientists are sometimes asked to investigate an area and develop baseline data before a construction project takes place. If the proposed changes are on a large scale, environmental impact statements are required. To determine the actual effects of the development, data must also be collected during and after completion of the project.

This activity describes random plot sampling and systematic sampling using transects. Your students can use either one or both of these methods to monitor local changes. Standardize your sampling techniques as much as possible so that classes year after year can collect and compare data. Sample not only your spot, but also a local development site or polluted spot. If you live in an area impacted by an oil spill, choose this as your site.

Discuss planned development projects with city planners or members of the village council. Ask their advice on what area to study and also on what types of information would be most helpful to them for your class to study. Interview a person from the US Coast Guard, the US Fish & Wildlife Service, or the ADF&G to find out how extensive the problem of plastic debris or oil pollution is in Alaskan waters. The Alaska Sea Grant Program has many handouts on plastic debris and beach clean-ups.

The data your class collects may be of real use in the future, so be sure to save your field notes and the report summarizing your findings.

PROCEDURE:

1. Decide on a study site. Ask students to describe how they would find out about the plants and animals living at this site. Plan to try out some of their suggested methods. Then explain the following two sampling techniques. Both require a supply of frames; these can be of any size, so long as the same size is used consistently in any one study. Coat hangers pulled into squares make handy plot frames, but wood or metal frames can also be used.

Random Plot Sampling: Explain that to make their plots random, each pair of students should stand along an edge of the site, close their eyes and throw their coat hanger inside. After counting and recording all the plants and animals inside the frame, they should close their eyes and throw again, proceeding in the general direction of the opposite side of the study site. Each pair should complete 5-10 plots (whatever is agreed on beforehand and what time allows).

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Systematic Sampling Using Transects: to make transect lines, stake 100 ft. ropes (use nylon-cotton, as it will not stretch) across the study site. The ropes should be numbered consecutively and marked off ahead of time with adhesive tape every three feet or at some other regular interval. If your study site has a variety of habitat types (including, for example, tundra, marsh and lake) your transect lines should be laid out to cross all of them. Teams of two students each, using the coat hangers, should take sample measurements along the transect line at the taped intervals.

2. For both types of sampling, at least two of the study site corners should be marked with stakes or by some other means. If transect lines are used, these also should be marked, so that the study can be duplicated in the future.

3. Each team of two students should record its findings in a small pocket notebook. (Notebooks can be made by cutting sheets of scrap paper in quarters, then stapling them together. Punch a hole in one corner and tie a pencil to it with a string). Students should head their notes with the date, time, location and weather. While sampling, one student of each pair can count while the other records. A separate page of the notebooks should be used for each plot.

Have students write down the names of all species of plants and animals inside, or at least more than halfway inside, their square. If students cannot identify something, ask them to draw a picture or write a description. Students should make as accurate a count as possible of each species within the square. If there are too many to count, they can estimate by counting the number within one square inch, then multiplying by the number of square inches in the plot.

If grasses, algae or other plants are not too dense, they can be counted individually. Otherwise, have students measure the surface area, in inches, that each species occupies. Make a note of inanimate evidence of life found in a plot—detached seaweed, seashells, bird feathers, animals tracks, or droppings.

4. To be sure that students understand the procedures, you may want to try sampling in the classroom or on the school playground before you do your field study. Place construction paper plants and animals on the floor or ground. Then have students mark and measure their study site, sample using random plots or a transect, and summarize data.

5. When you arrive at the study site, have each student estimate how many plants and animals are living there.

6. Assign at least one team to do an inventory of all the garbage found at the site. List and catalog the kinds of pollution deposited on the shore. Be specific. Mark the kinds of debris that are not biodegradable. While you are there, collect the debris and put it in a garbage container, except for the garbage that you can recycle.

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7. Assign one team to be reporters. They can photograph or draw the entire operation and interview the biologists at work. Be sure they photograph or draw the study site and the bench marks at the beginning and end of each transect. Have students write a story about their class findings for your local school or community newspaper or parent newsletter.
8. Another team (more than one team if there is time) should draw a map of the study site showing prominent biological, geographical and geologic features, along with any man-made features. One student can establish scale for the map by measuring his or her normal stride with the yardstick, then pacing off the size of the study site.
9. After the teams have finished their sampling, hold a summary session. Have each pair tell briefly of its findings. Try to look at the study site as a whole. What are its general characteristics?
10. Back at school, have each team record its findings on a data summary sheet. (A data summary sheet can also be used in the field instead of the field notebooks. If you have been to the study site before and are aware of what you will find, you can draw up your own sheet ahead of time. Or students can make their own as they go along by writing down each plant or animal the first time they find it).
11. Have the teams make bar graphs of their results, so that they can see graphically how populations of animals and plants vary at your study site.
12. To compute the average number of animals or plants per plot, divide the total number recorded by the number of plots sampled. To figure the number of animals or plants on the entire study site, use this formula:

$$\frac{\text{total square inches on study site}}{\text{total square inches in all plots}} =$$
$$\text{average on plots sampled} \times \text{total plots} = \text{total creatures on study site}$$

For example, say you found a total of 1500 barnacles in 10 plots. $1500/10$ gives you an average of 150 barnacles per plot. Figure out the number of square inches in your coat hanger plot (9 x 9" coat hangers = 81 sq. in.) and the average number of barnacles per square inch:

$150/81 = 1.85$ barnacles per sq. in.

Now to estimate the number of barnacles on your study site, figure the number of square inches in your study site. Assuming a site 100 ft. x 40 ft.:

$100 \times 40 = 4,000$ sq. ft. $4,000 \times 144$ (sq. in. per sq. ft.) = 576,000 sq. in.

FIELD TRIP TO THE BEACH

and $576,000 \times 1.85 = 1,065,600$ barnacles in your study site.

These figures may be more meaningful if they are translated into creatures per acre. One acre equals 43,560 sq. ft. or 6,272,640 sq. in. Thus, in the example:

$1.85 \text{ barnacles/sq. in.} \times 6,272,640 \text{ sq. in./acre} = 11,604,384 \text{ barnacles per acre.}$

12. Have students analyze and summarize their data. Ask them:

What species are most abundant?

What species are most widely distributed?

Is there much size range within individual species?

What species are present but represented only by a few individuals?

What natural changes are occurring within the study site?

What accounts for the abundance of life in the sample plots?

What human changes do you foresee in the future for this area?

What human changes are evident now?

How will the animals and plants change in response to these human changes?

What kinds of things are being done to encourage proper disposal of garbage and wastes from boats?

13. Show your results to local officials and **SAVE YOUR FIELD NOTES AND SUMMARY REPORT!** Emphasize to students that their data will be kept and compared with additional data taken the following year at the same time. (Or if possible, repeat the above sampling scheme in the fall, winter and spring, to measure seasonal change in the study area.) But most important is the fact that in some remote areas of Alaska, your surveys may be the only ones that have ever been made. Your reports might be of real help to scientists!

EXTENSIONS:

1. Science: Have students measure and record sizes of the largest and smallest plants and animals within the plots.

2. Science/language arts/art: Have students write questions they have about their findings and about specific plants and animals. Then research the answers to these questions and design an attractive bulletin board display with the results.

3. Language arts: Have you had a personal experience with ocean pollution of some kind? Tell about it.

4. Social studies: Organize your own beach clean-up in your area. Report your success.

5. Art/language arts: Make a poster that describes ocean pollution and suggests ways to

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combat this pollution.

6. Art/photography: Make a photo essay of the debris or pollution you find in your coastal area. Write short descriptions beneath your photos and mount them on a poster.

VOLUNTEERS CAN MAKE A DIFFERENCE

BY: Belle Mickelson

DURATION: 2 periods

SUBJECTS: Social studies, language arts

OBJECTIVES: Students will discuss the role of volunteers in the oil spill clean-up. Students will investigate the importance of volunteers in their own community. Students will volunteer a few hours to make their own community a better place. Students will compare their own efforts with the oil spill volunteers and write about their feelings.

BACKGROUND: As soon as the *Exxon Valdez* oil spill happened, thousands of Alaskans and people all over the world rushed to help. Those who could not come sent letters, moral support, and/or money. In the impacted communities it was important for people to feel like they were helping in some way. Some people were paid employees, but thousands of others were volunteers, who gave countless hours of their time. Disasters like the *Exxon Valdez* oil spill do not happen very often, but in every community there is someone and something that needs your help. People feel better when they help others.

PROCEDURE:

1. Read some of the news articles at the back of the curriculum. Ask students if they know anyone who volunteered to clean up the spill. What did they do? How did they feel? Why did they do it?

People cleaned birds and otters, volunteered boats and equipment, staffed offices, set up a volunteer hotline, helped with scientific studies, took care of other folk's kids, made oil containment booms, talked to the press, made phone calls, wrote thank you letters, drew pictures, made baked goods for the oil spill workers,



MATERIALS:

- Journals
- Pencils
- Articles about oil spill volunteers
- Local newspaper

VOLUNTEERS CAN MAKE A DIFFERENCE

picked up their own beaches, contributed money, and wrote this curriculum. Some workers were paid — and paid well — but there were also many people who contributed and are still contributing.

2. Ask students what volunteer projects they have done. Did they like them? How did it make them feel?
3. Discuss volunteer projects that could be done in your own community: visit elders in the hospital or in your own neighborhood, help a parent with his or her children or help at a childcare center, clean your local parks, serve meals to the needy, or stuff mailing envelopes for an environmental group. Check your local newspaper for other ideas.
4. Pick a project as a class or individual.
5. Have each student do at least 2 hours of volunteer service in the community.
6. Have students reflect on their experience in their journals.

NATIVE USES OF THE COAST

Adapted by Elizabeth Trowbridge, from the Alaska Sea Week Curriculum, Vol. VI

SUBJECTS: Social studies, Alaska studies

DURATION: 1 Period

BACKGROUND: The Chugach and Eyak Eskimos and the Aleuts have inhabited the shores and waters of Prince William Sound and southcoastal Alaska for ages. They depended upon the waters and the land for food and shelter. Alaska Natives still depend heavily on a subsistence way of life even though they are part of a cash economy. Rural lifestyles and traditional ways make subsistence activities essential. Coastal waters have provided herring, salmon, crab, mussels, seaweed, shrimp and a variety of invertebrates, among others, for food and livelihood. Terrestrial mammals that feed off of marine life have been very important resources for Alaska Natives. The *Exxon Valdez* oil spill truly impacted the Native villages found in southcoastal Alaska. Not only did it destroy their subsistence food supply, it threw thousands of dollars into their economy; in most villages, money is not necessarily what is needed. Alaska Natives need to be sure their lifestyle will be stable, and their traditional food source and livelihood will be intact; they do not need a false economy that will only last for one or two years. What is left is an uncertain future and a changed culture. The following worksheet and article written by a Native elder are meant to increase the students' awareness of the lifestyles of southcoastal Alaska Natives and the impacts of the oil spill on those lifestyles and cultures.

PROCEDURE:

1. Hand out and read, as a class, the article by the Native elder, Walter Meganack Sr. Discuss what it means to depend upon the land and water for your food and shelter. Read other news articles such as: "Spill Stench Permeates



MATERIALS:

- "Coping with the Time the Water Died" by Walter Meganack Sr.
 - "Crude Reminders 10 Years After 'The Day the Water Died' -- pain of Valdez spill still stings in Alaska"
 - "Future of Village in Doubt"
 - Paper
 - Pencils/pens
 - Journals
 - Foxfire books
- Worksheet:
Native Uses of the Coast

NATIVE USES OF THE COAST

Aleut Village” and “Future of Village in Doubt.” Review the Native groups of Alaska, their lifestyles and general subsistence characteristics. Use a large map of Alaska to mark the Native groups of Alaska.



2. Hand out the Native Uses of the Coast worksheet and have students complete either individually or in groups. Discuss #6 & 7 as a class. Have different students relate their views of the community 100 years ago. Ask some to describe what they think the community will be like 100 years from now! What changes in lifestyle might occur and how would this affect their personal, family and community life. You may want to have the students respond to this in their journals.

3. One of the most sensitive issues facing the Alaska Natives in Prince William Sound and southcoastal Alaska is that of the impacts of beach cleaning and “cleaners” on archaeological remains. Many beach workers may be tempted to take artifacts that are found. Non-Natives view these remains as “artifacts;” to the Alaska Natives in this area these are the remains of their ancestors and cultural heritage. Try to personalize the issue by asking students how they would feel if their grandparents remains were uncovered and stolen. Find pictures or replicas of artifacts and speculate as to their usage. Have students try to create a profile of settlement patterns in Prince William Sound and southcoastal Alaska based on artifacts and archaeological remains. Refer to other lessons for information on habitat and wildlife characteristics.

4. Have students try to define their “cultural values.” List them on the board, then have students prioritize them in their journals. Have them defend their number 1 and 2 choices. Now tell them that something has happened and these highly prioritized values have been destroyed. (For example, they are not able to be with their family at Christmas, or they can no longer visit local parks due to construction or destruction). What would this mean to the students and their families? What sort of actions might they take as a result of these changes? Have them reflect on these thoughts in their journals.

4. Interview an elder in your community. Put together a book of compiled stories or interviews to be shared throughout the community. Have each student or a group of students interview an elder asking questions about their lifestyle when they were young, changes that have occurred and what these changes have meant to them personally. Use the Fox-fire books, and Shandaa: In My Lifetime, ed. by Bill Pfisterer for ideas about format and content. Include photographs and drawings if possible. You may want to coordinate with an art or photography class to help compile the book. Include maps, personal background of the elder interviewed and anecdotes from their life story.

NATIVE USES OF THE COAST



Map courtesy of Alaska Native Heritage Center.

1. Write the names of nine Native groups on the map above, showing their traditional areas.
2. Describe the Native groups in your area. They are called

How did they use the coast traditionally?

Now?

In times long ago, they lived in

and hunted with

They used _____ for transportation on the seas and rivers.

Now they live in _____ and use _____ for transportation on the seas and rivers.

One word in their language is

It means

3. Compare the ways two of Alaska's Native groups depend on the coast.

NATIVE USES OF THE COAST

Five similarities are:

Five differences are:

4. Name the 5 most important food items to Alaska Natives in southcoastal Alaska:

1. 2. 3. 4. 5.

If you live in a different area of the state, name the 5 most important food items for the Native group in your area:

1. 2. 3. 4. 5.

5. Who are the major employers in the villages in your area?

How many jobs do they provide for the local population?

How would you describe the economic base of the villages near you? (subsistence based, cash economy, oil based, commercial fishing, etc.)

NATIVE USES OF THE COAST

6. Compare and contrast the lifestyle of the Native groups in southcoastal Alaska:

100 years ago

pre oil spill

post oil spill

Food source

Economic base

Transportation

Cultural value

7. Describe life in your community 100 years ago through the eyes of a student your age. Tell why the coast is important to you.

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OIL SPILL RESPONSE

BY: Belle Mickelson

DURATION: 2 periods

SUBJECTS: Social studies, language arts

OBJECTIVES: Students will read articles about how different individuals, agencies, and organizations responded to the spill. Students will discuss the role, and difference, of each group of respondents. Students will write about their response to an oil spill in their community.

BACKGROUND: On Good Friday, March 24, 1989, Alaskans “awoke to the shock of disaster. Shortly after midnight, the 987-foot-long supertanker, *Exxon Valdez*, had run hard aground on Bligh Reef, spilling 10.8 million gallons of crude oil into the unspoiled waters of Prince William Sound. The worst case had occurred.”

“This was the threatened tanker catastrophe residents of Prince William Sound had dreaded—but many had come to discount—ever since the trans-Alaska pipeline was proposed in the late 1960’s...” (from *SPILL*, the Report of the Alaska Oil Spill Commission)

Individuals, organizations, communities, agencies, and industry moved into high gear to respond to this emergency. For volunteers and employees alike, this meant long hours and high levels of stress. They worried about their economic future and way of life, dealt with the death of birds and animals, and the oiling of their incredibly gorgeous environment. There was a tremendous sense of helplessness and, for many, the need to try to rectify what had gone wrong. Disorganization was prevalent. Greed and infighting among some people contrasted with the idealism, leadership, and dedication of others.

Many people went through the traditional grieving stages that one sees when there is a death in the family (shock/denial, anger,



MATERIALS:

- Paper
- Pencils
- “CDFU to the Rescue”
- “PWSAC Watches Over Hatcheries”
- “Oil Spill Accelerates Science Center”
- “Children’s Task Force Goes to Work”
- “PWSCC Assists Community”
- “Seldovia Puts Up Its Own Defense Against Oil”
- “Homer Residents Begin Building Booms”
- Alaska Fish & Game “Special Oil Spill Issue”

OIL SPILL RESPONSE

bargaining, depression, acceptance). In this case, “family” was an area that they loved and treasured; for many, an area on which their whole way of life depended.

PROCEDURE:

1. Ask the students to remember their first thoughts after they heard about the spill. Ask them what they did and what people they know did in the weeks that followed.
2. Divide the class into groups. Have each group focus on different individuals, agencies, and organizations and read articles about how they responded to the spill. Come together as a class and have each group report on their response team. Be sure to focus on the type of response action, i.e. volunteer, organizational, agency, individual; the emotional aspects of the response; what the response group hoped to accomplish and what they actually did accomplish (this could range from feelings and personal satisfaction to actual saving of animal lives or fisheries).
3. Have students write a paper about what they would do if an oil spill happened in their community.

EXTENSIONS:

1. Social studies: Invite a social worker or psychologist to talk to the class about the effects of a disaster on communities. In Alaskan southcoastal communities directly affected by the spill, it is important that students have a chance to talk about what they felt when the spill occurred. They need to feel good about what they did, and can do, to prevent future spills (energy conservation, recycling, etc.).
2. Social studies: Go on a field trip to city hall and the fire department to talk about their contingency plans for disasters.

BIOETHICAL DECISION MAKING

BY: Liz Burck

SUBJECTS: All

DURATION: Minimum of 1 period

OBJECTIVES: Students will demonstrate decision-making skills by evaluating personal values.

BACKGROUND: Decision-making is a life skill which challenges the student to evaluate personal values. It is essential for education. The oil spill, then, lends itself to this exercise quite readily. That challenge is an integral part of the energy (oil spill) controversy and, ultimately, an integral part of societal expectations of our youth.

PROCEDURES:

1. Hand out the response forms and the "I" Values form.
2. Define and discuss ethics.
3. Go over all the steps - including a review and/or explanation of the "I" values.
4. Practice using the model by suggesting a bio-ethical problem to which the students can easily relate. For example: What ought I do when the landfill is closing in three months and I know that I will continue to generate garbage.
5. Brainstorm ethical issues related to the oil spill.
6. Choose one issue at a time to use with the model.
7. Have the student complete the model. NOTE: Individual responses cannot be graded (too subjective) but can be checked for understanding and/or completion.
8. The responses can then be used to stimulate or generate classroom discussions, or the students can reflect in their own journals.



MATERIALS:

Worksheets:

- Bio-ethical Decision-Making Model
- "I" values form

BIOETHICAL DECISION MAKING

(Adapted from the Jon R. Hendrix/Pat Somers Model, Ball State University)

Name _____

I. State the bioethical problem. State problem as an ought to do question (e.g., “What ought I do when....”)

II. List possible alternative actions or solutions to the problem, even if you don't agree with some. (Five is the minimum.)

Ranking _

Solutions

1.

2.

3.

4.

5.

6.

7.

8.

BIOETHICAL DECISION MAKING

III. Rank these alternatives in order of preference by placing numbers beside them. For example, place #1 beside the first choice, #2 beside the second, etc. (Rank them from the one (#1) your values agree with most to the one (#?) your values agree with least.

IV. Take your #1 solution and list at least 5 values you hold that cause you to rank it #1.

"I" Value

Personal Meaning of Value Word

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.

V. Now take your solution and describe the CONSEQUENCES you think it would have. Use any 5 of the long term and short term consequences.

How would this solution
affect my:

Short Term

Long Term

Money

Time

Personal relationships

Family

Friends

Psychological self

Community

Country

BIOETHICAL DECISION MAKING

VI. Place a (+) beside each consequence you hold as "good" and a (-) beside each consequence you hold as "bad."

VII. Are there any real "bad" consequences that you couldn't live with? If so, try another solution or modify your solution.

VIII. List 3 reasons why others might not agree with your solution to the problem.

1.

2.

3.

IX. Restate your solution and then place a confidence or conviction measure on it by Xing the number on the confidence scale below.

My solution:

I can live with my solution

I cannot live with my solution

1

2

3

4

(From the Mertens/ Hendrix Model from Ball State University)

NOTE: Cross out values that have no meaning for you and add others that do have meaning for you. Be sure to define the ones that you add.

BIOETHICAL DECISION- MAKING MODEL - "I" VALUES

ACHIEVEMENT: Accomplishment; a result brought about by hard work to attain a desired goal.

AESTHETICS: The appreciation and enjoyment of beauty for beauty's sake.

ALTRUISM: Concern for the interests of others.

AUTONOMY: Self-directed, capable of existing alone; acting without aid of others.

BEING LIKED: Being held in favor or regard by others.

COOPERATION: Working together for a mutual benefit.

CREATIVITY: Initiating new and innovative ideas and designs.

EDUCATION: The process of gaining knowledge and skills while developing reason, judgement and intellectual maturity.

EMPATHY: The ability to share in someone else's feelings.

EMOTIONAL WELL-BEING: Freedom from overwhelming anxieties and barriers; a peace of mind; inner security.

EQUALITY/RIGHTS: Correspondence in quality, degree, value, rank or ability.

FAMILY/BELONGING: Related by blood or marriage

FRIENDSHIP: The state of one person being attached to another by feelings of affection or personal regard.

HEALTH: The soundness of one's body.

HONESTY: Fairness of straightforwardness or conduct; integrity; uprightness of character or action.

HUMAN DIGNITY: Holding all humans in high esteem regardless of age, race or creed.

INTERDEPENDENCE: The mutual need for support, aid, comfort, etc.

INTIMACY: A close, familiar, and usually affectionate or loving personal relationship.

JUSTICE: The quality of being impartial to treat others fairly or adequately.

KNOWLEDGE: The seeking of truth, information, or principles for the satisfaction of curiosity, for use, or for the power of knowing.

LOVE: Affection based on admiration or benevolence; unselfish devotion.

LOYALTY: Maintaining allegiance to a person, group, institution, or political entity.

MORALITY: The moral values held by an individual or society.

OWNERSHIP: To have or hold material objects or to acknowledge specific ideas as being part of your ideology.

BIOETHICAL DECISION- MAKING MODEL - "I" VALUES

PERSONAL HEALTH: The condition of being sound in body; freedom from physical disease or pain; the general condition of the body, well-being.

PHYSICAL APPEARANCE: Concern for the beauty of one's own body.

PLEASURE: The agreeable emotion accompanying the possession or expectation of what is good or greatly desired; a state of gratification.

PRESTIGE: Holding a position of high value relative to society standards.

POWER: Possession of control, authority, or influence over others.

RECOGNITION: Being made to feel significant and important; given special notice or attention.

RELIGIOUS BELIEFS: One's convictions or opinions about religion, faith, devotion, etc.

SELF-CONTROL: Restraint of oneself or one's actions, feelings, etc.

SELF-PRESERVATION: Looking out for your own welfare.

SELF-WORTH: A feeling of being useful and/or held in high esteem by others.

SKILL: The ability to use one's knowledge effectively and readily in execution or performance; technical expertise.

SOLITUDE: The state of being removed from society; a quiet life.

TRUTH: An ideal abstraction conforming to a universal or generalized reality.

WEALTH: Abundance or valuable material possession or resources; affluence.

WISDOM: The ability to discern inner qualities and relationships; insights, good sense, judgment.

WORK/LABOR: Exertion or effort directed to produce or accomplish something; toil, effort.

MOCK SENATE

Adapted from: Barbara Browning, Homer High School

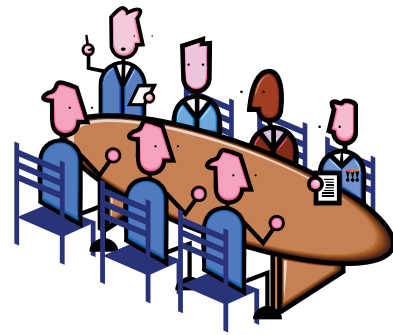
SUBJECTS: Social studies, government

DURATION: 2 weeks

OBJECTIVES: Students will participate, understand, and be successful in a senate simulation. Students will experience the give and take, the party alliances, and the stress and preparations involved in passing legislation.

BACKGROUND: As a result of the *Exxon Valdez* oil spill many types of legislative bills have been introduced both at the state and national level. Introducing new, or changing old, legislation is a long and complicated process yet one that should be understood by citizens. Understanding the difficulties in making and changing laws will help students gain insight into the political process and the challenges of trying to implement change. The mock senate exercise is an opportunity for students to research issues of importance to their state and to role play the political process where they will introduce bills important to them. The Mock Senate exercise, developed by Barbara Browning, has been used with high success rates in her Homer High School classroom. Students enjoy being involved in the entire process.

The Senate can hold subcommittee hearings, committee hearings, and then, a final hearing on the floor before the full Senate for each issue or bill. Finally, one bill is passed out of the Senate. The same happens in the House. The Senate and House then get together in conference and basically make trade-offs, concessions, compromises, etc., to pass one combined bill. The bill goes to the President who signs it into law or vetoes it.



MATERIALS:

- Example bill
- Mock Senate Guidelines
- Roberts Rules of Order
- Oil Spill Legislation info sheets

MOCK SENATE

PROCEDURE:

1. Ask students if they remember learning about the process of passing a bill. List, on the board, points and procedures they remember. Ask students how they think companies such as Exxon are regulated. What do they think it takes to set aside land as a national park or a wildlife refuge? Introduce the idea of a "Mock Senate" where students will actually play the roles of legislators and write and pass bills.

2. Each student must pick a party affiliation and research their own state to find oil spill/energy issues and view points of their state and their party. They will present a state profile. (see Mock Senate Guidelines). Have students present their information in outline form. Elect or appoint a President of the Senate and a Secretary. Have the President review the roles of each "elected official." Inform them that the President will be responsible for presenting a sample bill and explaining the rules of conduct in the senate.

3. Introduce the sample bill. Review the format. Have students copy the format in their journals. Tell the students they will be responsible for introducing two (2) bills. One bill must concern an energy-related economic change that would benefit their state and/or nation; one must solve or deal with an oil related problem in their state and/or the nation.

4. This exercise assumes that the students are already familiar with party roles, legislative proceedings, passing bills, etc. If this is not the case, you will need to review some of these aspects with the students.

The senate proceedings should run by Roberts' Rules of Order. Students should be encouraged to assume the viewpoints of their respective party affiliation. The bills they introduce should also reflect their party's viewpoint.

5. During the Senate sessions have students submit a newspaper item about the Senate proceedings. It may be an article, letter to the editor, political cartoon, etc. It must concern someone or something that happens in the Senate proceedings. It should be typed or drawn in black ink.

6. The key to the success of the Mock Senate is participation. Students need to be encouraged to introduce bills or amendments and to speak in defense of or in opposition to other bills, etc. The Mock Senate should be in session for at least one week in order to give students ample time to participate in the entire process.

7. Each day, take the first 5 minutes and have the students write a reaction to the session the day before either in their journals or on 8x10 note cards.

8. As a final activity, have published in the school paper a list of bills passed by the Senate. Have the sponsors of each passed bill write a short summary of the purpose and intent of the bill. Compare bills passed in the Mock Senate to state and federal legislative happenings.

MOCK SENATE GUIDELINES

PRESIDENT OF THE SENATE:

1. You must plan and deliver a presentation on the rules of conduct in the Senate (Roberts' Rules of Order).
2. Plan a bill that will be presented to the class as an example.
3. Prepare and give a quiz on the following day.
4. When in session, be present every day, maintain order, run by the rules you establish.

SECRETARY:

1. You must be present every day. If the President cannot be present, you will be expected to run the Senate.
2. Make a poster of all the Senators and their political parties and highlight socioeconomic characteristics of your state.
3. Keep a daily summary of bills introduced, passed and amended.
4. If your school has a newspaper, have a printed summary of the bills and the action on the bills.

STATE PROFILE:

- A. State name
- B. State Government: strongest political party, male to female ratio of Senators and Representatives, political parties, anything else of interest.
- C. Economics: types of industry, unemployment rate, income levels, poverty rate, job growth rate, tax base, spending, etc.
- D. People: population, changes in population, urban/rural ratio, racial mix, religion, age spread, etc.
- E. Other: education, violent crimes, major concerns or problems, environmental concerns, pollution, development, etc. These should be items that as a Senator, you want to try to solve, or would influence how you vote.

MOCK SENATE - Example of a Bill

Senate Bill No. _____

In the Legislature of the state of _____

_____ (#) Legislature - _____ (1st or 2nd) session.

A Bill

For an Act entitled: "An Act Concerning"

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF _____:

Section 1.

Section 2.

OIL SPILL LEGISLATION

Oil Pollution Act of 1990 (OPA 90)

OPA 90: Terminal and Tanker Oversight and Monitoring (Legal Information Institute website): http://www4.law.cornell.edu/uscode/html/uscode33/usc_sec_33_00002732---000-.html

OPA 90: Prince William Sound Provisions (Legal Information Institute website): http://www4.law.cornell.edu/uscode/html/uscode33/usc_sup_01_33_10_40_20_II.html

Entire OPA 90 document (PWSRCAC website): <http://www.pwsrcac.org/docs/d0000200.pdf>

Alaska Statutes

TITLE 26. MILITARY AND VETERANS AFFAIRS/CHAPTER 23. DISASTERS/ARTICLE 1. ALASKA DISASTER ACT

Sec. 26.23-077(c) Plan Review: Incident Command Systems : An incident command system recommended or included under this section must provide that the Department of Military and Veteran's Affairs has a major role in mobilization of personnel and resources, communications, transportation planning and other logistics involved in a state response to a disaster or other emergency.

TITLE 46. WATER, AIR, ENERGY AND ENVIRONMENTAL CONSERVATION/CHAPTER 3. ENVIRONMENTAL CONSERVATION/ARTICLE 2. DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Sec. 46.03.759 Civil Penalties for Discharges of Crude Oil: Civil penalties for discharges of crude oil. Anyone found liable under any state law for an unpermitted discharge of crude oil in excess of 18,000 gallons is liable for penalties, damages, the cost of containment and cleanup, and liable to the state for a civil penalty up to \$500,000,000. Determines the formula for how many gallons of crude oil have been discharged for purposes of assessing a penalty.

TITLE 46. CHAPTER 4. OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTROL/ARTICLE 1. OIL POLLUTION CONTROL

Sec. 46.04.010. Reimbursement for Cleanup Expenses. The department shall seek reimbursement under AS 46.03.760 (d), AS 46.08.070 or an applicable federal fund for expenses incurred in cleanup or containment of a discharge of oil. Money received by the department shall be deposited in the general fund.

TITLE 46. CHAPTER 4. OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTROL/ARTICLE 1. OIL POLLUTION CONTROL

Sec. 46.04.030. Oil Discharge Prevention and Contingency Plans: The following are not permitted unless an oil discharge prevention and contingency plan has been approved and the person is in compliance: cause or operation of an oil terminal facility in the state; operation of a pipeline, exploration or production facility in the state; operation of a tank vessel or an oil barge within the waters of the state or cause or permit the transfer of oil to or from a tank vessel or oil barge.

OIL SPILL LEGISLATION

When the contingency plan has been approved a certificate of approval shall be issued by the state. The contingency plan must be submitted for renewal every three years.

Reasonable terms and conditions may be attached to the contingency plan being approved or modified to ensure the applicant has access to sufficient resources to protect environmentally sensitive areas and to contain, clean up and mitigate potential oil discharges.

The department may modify approval of a contingency plan if it is determined a change has occurred in the operation of a facility or vessel or the operator's discharge experience demonstrates a necessity for modification. Outlines who can approve, modify or revoke a contingency plan and under what conditions and circumstances a plan can be approved.

TITLE 46. CHAPTER 4. OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTROL/ARTICLE 1. OIL POLLUTION CONTROL

Sec. 46.04.040. Proof of Financial Responsibility: Establishes under what financial conditions the operation of an oil terminal facility may be permitted and what the specific financial responsibility for incidents shall be. Establishes how to determine financial responsibility

TITLE 46. CHAPTER 4. OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTROL/ARTICLE 2. OIL AND HAZARDOUS SUBSTANCE DISCHARGE AND PREVENTION CONTINGENCY PLANS

Sec. 46.04.200. State Master Plan: Outlines all elements of a prevention contingency plan, and under what conditions and how a plan can be modified.

TITLE 46. CHAPTER 8. OIL AND HAZARDOUS SUBSTANCES RELEASES/ARTICLE 1. RELEASE PREVENTION AND RESPONSE FUND; REIMBURSEMENT; LIENS

Sec. 46.08.070. Reimbursement for Containment and Cleanup: States when and how the commissioner shall seek reimbursement costs for oil spill containment and cleanup.

TITLE 46. CHAPTER 8. OIL AND HAZARDOUS SUBSTANCES RELEASES/ARTICLE 2. OIL AND HAZARDOUS SUBSTANCES RESPONSE FUND

Sec. 46.08.100. Office Established: Establishes the oil and hazardous substance response office including a director and employees specifically in programs and technologies related to the containment and cleanup of threatened releases of oil and hazardous substances.

ALASKA STATE STATUTES & CODES

Alaska State Statutes that address tankers (transport of crude oil).

08.62.010: Establishment of Board of Marine Pilots & qualifications and examination of pilots.

46.04.030: Lease expenditures related to the costs of production of oil and gas.

29.35.020: Financing of oil & hazardous substance release prevention account.

OIL SPILL LEGISLATION

46.03.822: Strict liability for the release of hazardous substances related to the owner and/or operator of a vessel.

46.08.080: Legislature may appropriate from the Oil & Gas Substance Prevention Account.

46.04.055: Oil response contractors: a response action contractor who responds to a release

or threatened release of oil is not civilly liable for removal costs or damages that result from an act or omission in the course of providing care, assistance, or advice if the contractor is listed in the contingency plan.

38.35.120: Assumes the status of and will perform all of its functions undertaken under the lease as a common carrier and will accept, convey and transport without discrimination crude oil or natural gas.

Alaska Administration Code 18/Environmental Conservation/Oil and Hazardous Substances Pollution Control: Owner/Operator of an oil tank vessel, oil barge, pipeline, oil terminal, exploration facility or production facility is responsible for meeting the applicable requirements and for preventing the discharge of oil into waters or onto land of the state.

1. Oil Pollution Prevention Requirements (18 AAC 75.005 - 18 AAC 75.090)
2. Financial Responsibility for Oil Discharges (18 AAC 75.205 - 18 AAC 75.290)
3. Discharge Reporting, Cleanup, and Disposal of Oil and Other Hazardous Substances (18 AAC 75.300 - 18 AAC 75.396)
4. Oil Discharge Prevention and Contingency Plan and Nontank Vessel Plans (18 AAC 75.400 - 18 AAC 75.496)
5. Oil Spill Primary Response Action Contractors and Nontank Vessel Cleanup Contractors, Incident Management Teams, and Response Planning Facilitators (18 AAC 75.500 - 18 AAC 75.580)
6. Civil Penalties for Discharge of Petroleum and Petroleum Products and Byproducts (18 AAC 75.605 - 18 AAC 75.670)
7. Surface Oiling (18 AAC 75.700 - 18 AAC 75.730)
8. Oil Discharge for Scientific Purposes (18 AAC 75.800 - 18 AAC 75.830)
9. General Provisions (18 AAC 75.905 - 18 AAC 75.990)

FEDERAL

U.S. Codes/"transport of crude oil"

US Code: Title 42,6240. Petroleum Products for Storage, Transport or Exchange
Title 42. The Public Health and Welfare/Chapter 77 - Energy Conservation/
Subchapter I - Domestic Supply Availability/ Part B - Strategic Petroleum Re-

OIL SPILL LEGISLATION

serve

US Code: Title 42,9601. Definitions
Title 42 - The Public Health and Welfare/Chapter 103 - Comprehensive Environmental Response, Compensation, and Liability/Subchapter I - Hazardous Substances Releases, Liability, Compensation

US Code: Title 43,2007. Decision of President
Title 43 - Public Lands/Chapter 38 - Crude Oil Transportation Systems

US Code: Title 42,6903. Definitions
Title 42 - The Public Health and Welfare/Chapter 82 - Solid Waste Disposal/Subchapter I - General Provisions

US Code: Title 43,2002. Statement of Purposes
Title 43 - Public Lands/Chapter 38 - Crude Oil Transportation Systems

US Code: Title 46, Chapter 37 Carriage of Liquid Bulk Dangerous Cargoes
Title 46 - Shipping/Subtitle II - Vessels and Seamen/Part B - Inspection And Regulation of Vessels

US Code: Title 50A, 2096. Synthetic Fuel Production Subsequent to Determinations Respecting a National Energy Supply Shortage of Defense Fuels
Title 50, Appendix - War and National Defense/Defense Production Act of 1950/Act Sept 8, 1950, CH. 932, 64 STAT. 798/Title III - Expansion of Productive Capac-

ity

And Supply

US Code: Title 50A, 2095. Synthetic Fuel Production Title 50, Appendix - War and National
al
Defense/Defense Production Act of 1950/Act Sept. 8, 1950, CH. 932, 64 STAT. 798/Title III - Expansion of Productive Capacity and Supply

OIL IN YOUR COMMUNITY

by Belle Mickelson and Elizabeth Trowbridge

SUBJECTS: Language arts, science, social studies

DURATION: 2 periods plus homework

OBJECTIVES: Students will investigate current and potential energy resources and usage in their own community.

BACKGROUND: Renewable energy resources are those such as solar and wind energy whose supplies are endless. However, our country relies heavily on non-renewable resources. The use of these resources is believed by many to be a prime factor in global warming. The drilling for oil and its transportation can have a major effect on our environment. Oil, though, is indispensable to our society and is used for a multitude of products. It is time we all took a good look our dependency on non-renewable resources and the best place to start is at home and in our community.

PROCEDURES:

1. Ask students what the energy resources are in their community. List their responses. Ask which energy resources used are renewable and which are non-renewable. What other energy resources are there in the community. Plan a trip to investigate these resources.

2. Distribute the Petroleum Tree Handout and Petroleum Products Checklist. Discuss what it means to be dependent upon so many petroleum products. Are students surprised that so many everyday items are made from petroleum?

3. Have students conduct a survey of current and potential energy resources in their home and community. Hand out the Home Energy worksheet and the Community Energy worksheet. Have students take the Home Energy



MATERIALS:

- Pencils
 - Chart paper
 - Markers
- Worksheets:
- Petroleum Tree Handout
 - Petroleum Products Checklist
 - Home Energy Worksheet
 - Community Energy Worksheet

OIL IN YOUR COMMUNITY

worksheet home to complete. Divide the class into groups and complete the Community Energy worksheet. Discuss the result of both surveys as a class. Which form of energy is used the most? What is the cost of each form of energy used in the community? How do they compare?

4. If there are residents who use a form of alternative energy such as solar or wind power get usage and cost per month data from them and compare to the standard energy usage and costs.

5. Take a field trip to investigate the sources of your community's energy. Look for mis-uses of oil (spills, improper disposal, lack of waste oil/gas facilities, oily trash, tarballs, oil streaks, oiled products on a beach). Look at the way oil products are disposed of in your landfill. How can the amount of trash entering your landfill be reduced?

6. Plan an education and clean-up program based on your studies. Work with the art class and village/city officials to design public education posters on cleaning up harbors, properly disposing of automotive/boat oil, conserving energy and recycling. Remember, economics is a prime motivator! Saving money is always a popular approach.

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HOME ENERGY WORKSHEET

1. How many kilowatts/month does your family use?
Collect one year's worth of data, or compare July's usage to December's usage.

2. Which appliance in your home uses the most energy?

a) Do you own:

- freezer
- refrigerator
- electric stove
- dishwasher
- microwave
- washer
- electric dryer
- hair dryer
- air conditioner
- electric fan
- TV
- stereo

b) Which could you do without?

3. a) Which types of energy does your family use?

ELECTRICITY ____ Name three uses: 1.
2.
3.

GAS ____ Name three uses: 1.
2.
3.

PROPANE ____ Name three uses: 1.
2.
3.

WOOD ____ Name three uses: 1.
2.
3.

OIL ____ Name three uses: 1.
2.
3.

HOME ENERGY WORKSHEET

b) Which costs the most to use?

4. Name three ways you could help reduce your family's energy consumption level.

1.

2.

3.

1. a) What is the major source of energy in your community? _____ (diesel, coal, oil, gas, wood)

b) Where does it come from? _____ (i.e. barge, local source, etc.)

2. How do most businesses heat their space?

3. How do most homes heat their space?

4. What are the three most prominent types of vehicles in your community and their gas mileage?

_____m/g

_____m/g

_____m/g

5. How much do each of these types of fuel cost in your community?

electricity

¢ /kh.

oil

¢ /gal.

propane

¢ /lb.

gasoline

¢ /gal. (regular)

¢ /gal. (unleaded)

diesel

¢ /gal.

fuel oil

¢ /gal.

Which is most expensive?

COMMUNITY ENERGY WORKSHEET

6. Rank the three most important forms of transportation in your community and the cost of their fuel.

1. _____ \$ _____/gal.
2. _____ \$ _____/gal.
3. _____ \$ _____/gal.

5. If all oil products disappeared what things would be left in your community? (name 10)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

EXTENSION: Begin collecting cost and consumption data and publish a quarterly graph in the school newspaper showing cost and consumption rates for your school and community.

COMMUNITY ENERGY WORKSHEET

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PETROLEUM PRODUCTS CHECKLIST

Check and circle those products that you find in your home and school, or those industries you are involved in:

GASOLINE ___ solvents, lighting, leather industry, motor fuel, heating, dry cleaning.

KEROSENE ___ heating, lighting.

LUBRICATING OIL ___ sewing machine oil, knitting machine oil, engine oil.

RESIDUAL OIL ___ insulation, paint, paving, artists crayons, graphite

PARAFFIN ___ candles, matches, canning industry, wax paper, chewing gum.

GREASE ___ grease, cable grease, railway, track and transmission grease.

FUEL OIL ___ furnaces, power plants, locomotives, diesel engines, industrial establishments.

GAS OIL ___ fuel gas, absorption oil, illuminating gas.

SPECIAL OILS ___ medicinal oil, switch oil for electrical equipment.

ARTIFICIAL RUBBER ___ tires, druggist supplies, cements, clothing.

ALCOHOLS ___ cleaning, solvent, preservatives, acetic acid.

AROMATIC HYDROCARBONS ___ explosives, saccharine, antiseptics, perfumes, dye-stuffs.

FATTY ACIDS ___ butter substitutes, edible fats, soaps.

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HOW MANY BARRELS DOES MY HOUSE USE?

by P.J. Bauer and Claudia Bain

DURATION: 10-15 minutes

OBJECTIVE: By calculating the number of barrels of oil used by their own households in one year, students will make the connection between their personal energy consumption and the cargo of the *Exxon Valdez*.

PROCEDURE:

1. Write this formula on the board: 22 barrels per person per year.
2. Begin by explaining that all of the energy used by a person each year can be expressed in oil equivalents. Experts tell us that in the U.S., on the average, a person consumes 22 barrels each year.
3. Have each child calculate how many barrels of oil his/her family consumes each year. How many barrels are used by the whole class together? By all of the families represented in the class? How can you calculate how many tankers come to your town in a year? Have the children compare their town's energy consumption to the 11 million gallons spilled in Alaska. (1 barrel = 42 gallons)
4. Using the formula, calculate the energy consumption, in barrels of oil, of your school, too. What else can you think of to measure this way?

EXTENSION:

1. Math: Use the worksheet How Much Oil to figure out how much 11 million gallons of oil is in descriptions that your students can understand.



MATERIALS:

- Pencil
- Paper
- Worksheet:
 - How Much Oil

HOW MUCH OIL?

Homer High School chemistry and physics students wondered just how much 10 or 11 million gallons of oil really is. They got busy with some calculations designed to make it a little easier to visualize, and instructor Richard Ingels shared it with the community.

- The oil would fill up over 4.5 Homer High School Commons to the top.
- The oil would fill up over 3.5 Homer High School gyms to the top.
- The oil would fill over 44 Homer High swimming pools.
- If one left the kitchen faucet running at full volume it would take over 9.7 years to get the same volume as the oil spill.
- The oil spill is equivalent in volume to 8.8 million cars draining their oil.
- If 45 percent of the oil was converted to gasoline, a car using the gas could go around the world almost 4,000 times.
- If 45 percent of the oil was converted to gasoline, it would take a person 7,933 years to use the gasoline (filling up once a week).
- The oil would fill 92 average houses to the ceiling.
- It would take over 15,300 pickup trucks to haul the oil.
- It would require a fleet of 3,143 large fuel trucks to carry the oil.
- If the oil were spread out on the Sterling Highway half an inch deep and 24 feet wide it would stretch about 279 miles (from Homer to Wasilla).
- If the oil were soda pop, every person in Homer would be able to consume one can every day for about 82 years.
- It would take about 332 million boxes of Kleenex to soak up the oil.

Now - figure some examples for your community.

ENERGY CONSERVATION

by Elizabeth Trowbridge

SUBJECTS: Social studies, language arts, science

DURATION: Minimum of 1 period

OBJECTIVES: Students will evaluate their own energy consumption patterns. Students will distinguish between renewable and non-renewable resources. Students will illustrate an understanding of alternative energy uses.

BACKGROUND: The March 24, 1989, *Exxon Valdez* oil spill made many impacted by the spill think more about energy consumption and conservation. Our dependency upon oil resources became much more obvious as we felt the immediate impacts of the spill. It is especially timely that we reconsider the issue of energy conservation and take a look at some of our consumption habits; even small changes in energy consumption can make a difference in how long our non-renewable resources last.

PROCEDURE:

1. As an introductory activity have students do the Energy Hog or Energy Hoarder worksheet. Discuss their "scores." Are they surprised by how energy intensive some of their habits are? Do they have any suggestions for raising their scores? Use this as a lead-in for discussion on renewable and non-renewable resources. (This exercise might need a little revision for southern climates!)

2. 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 research and list current prices of the various fuels and electricity costs. Discuss how energy influences lifestyles in your community. What do higher fuel costs mean to fishing boat captains, to canneries, to the price



MATERIALS:

- Markers
- Posterboard
- Worksheets:
 - Is Your House Drafty?
 - "Energy Hog or Energy Hoarder"
 - "50 Things You Can Do"

ENERGY CONSERVATION

of fish? (Change this to reflect the major industries in your community). (From Alaska Sea Week curriculum, Vol. VII).

3. Design a house, or room, that you would like to live in or build in 10 to 20 years. What climate will you be in? Label the location of your house, or room, and all the energy saving features it would include.

4. Distribute 50 Things You Can Do. Discuss some of the options. Have students make and illustrate a large poster to hang in the classroom, the hall, and/or the community. On posterboard, keep track of ways for the students who have tried to conserve. Make a large check list and monitor your successes daily.

5. Do an energy audit of your home or school. How can improvements be made? Have the class come up with a list of energy saving recommendations to present to the principal, such as caulking and weather stripping. You could also include a cost analysis of the recommendations. Students might want to do the same for their home.

6. Try to figure out how many barrels of oil can be saved in your community by energy conservation. Alaskan communities often have their fuel brought in by barge. Each barge not needed due to energy conservation means one less barge that might be involved in an oil/gas/diesel spill. Plus, the oil saved can be used for future generations. Discuss what oil saved means for your community.

ENERGY HOG OR ENERGY HOARDER

ENERGY HOG OR ENERGY HOARDER

(Reprinted from the Alaska Sea Week Curriculum Series, Volume VII)

Read and mark the answers that best describe what you do to save or use energy. Then total up your points: 70 points or more and you're an energy hoarder; 30 to 69 points you're not too bad; 29 to -29 need some improvement; and -30 points or less and you're an energy hog!

1. Do you turn the heat down and use lots of quilts and blankets at night? (7 pts) _____
....an electric blanket? (4 pts) _____
....or just keep the whole house warm? (-2 pts) _____
2. Do you grow some of your own vegetables? (5 pts) _____
....pick berries? (5 pts) _____
....hunt or fish for food? (5 pts) _____
....rely only on food from that Lower 48? (1 pt) _____
3. Do you eat food from the four basic food groups everyday? (5 pts) _____
....sometimes eat from the four basic food groups? (3 pts) _____
....like pop, candy and potato chips? (-1 pt) _____
4. In your spare time, do you always have your nose in a book? (5 pts) _____
....bicycle, hike, swim, jog, canoe, sail, or cross country ski? (5 pts) _____
....ride a three wheeler, in a car, motorboat, or on a snowmachine? (-5 pts) _____
....feel that your nose may one day become permanently glued to the TV? (-3 pts) _____
5. Is your house weatherstripped and caulked? (5 pts) _____
....real drafty? (-3 pts) _____
....or does it have holes big enough for voles (Alaskan mice!)
to come in through? (-5 pts) _____
(subtract another 3 pts if the holes are big enough for weasels!)
6. Are your windows single-paned? (1 pt) _____
....visqueened? (1 pt) _____
....double-paned? (5 pts) _____
....triple-paned? (8 pts) _____
....heat mirrored? (10 pts) _____
....argon filled? (10 pts) _____
7. Give yourself a point for each inch of insulation (or equivalent) _____
....in your roof _____
....in your floor _____
....in your walls _____
(if you have log walls, figure ½ pt for each inch of thickness)

ENERGY HOG OR ENERGY HOARDER

8. Add 4 pts if your house has a vapor barrier. _____
9. Is the temperature in your house in wintertime*
....warm enough for bikinis? (-7 pts) _____
....OK for T-shirts and shorts? (-5 pts) _____
....cool enough for light sweaters? (3 pts) _____
....requires heavy sweaters and wool shirts (5 pts) _____
*If your house is well insulated, you can still have it warm and be saving lots of energy, but there is such a thing as overheating!
10. Do you have a hot water heater? (-12 pts) _____
....add 5 pts if it is insulated _____
....add 5 pts if it is set at 120 F or less _____
....add 10 pts if it only heats "on demand" rather than having a tank continually filled with hot water _____
11. Do you cook several dishes in the oven at once? (5 pts) _____
....use the oven for one large dish? (2 pts) _____
....or use it to make toast in the morning? (-1 pt) _____
12. Do you boil water with the lid on the pan? (3 pts) _____
13. After washing clothes, do you hang them up to dry rather than using the electric dryer?
....never (-1 pt) _____
....in good weather (3 pts) _____
....in any weather (5 pts) _____
14. Do you turn off lights when you are not using them?
....never (-2 pts) _____
....sometimes (3 pts) _____
....always (5 pts) _____
15. Do you repair things when they break? (10 pts) _____
....or throw them away? (-5 pts) _____
16. Are your clothes
....from second-hand stores or hand-me downs? (8 pts) _____
....almost always new? (1 pt) _____
....only the finest designer specials? (-3 pts) _____
17. Do you recycle or reuse newspapers, cans, bottles, paper? (10 pts) _____

ENERGY HOG OR ENERGY HOARDER

18. Do you shut off the TV or radio when you're not using them? _____
....always (3 pts) _____
....sometimes (-1 pt) _____
....never (-3 pt) _____

19. Subtract 3 pts for each gas or electric appliance in your house. _____

20. Do you have solar panels, wind generator, geothermal, hydropower, air-to-air heat exchanger, or a heat pump in your house? (15 pts)

21. Add 3 pts for each additional way you save energy. Write them here. _____

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50 THINGS YOU CAN DO

IN YOUR HOME

- Learn where the energy for your home comes from.
- Investigate local recycling centers.
- Recycle everything you can: newspapers, cans, glass, aluminum foil and pans, motor oil, scrap metal, etc.
- Save your kitchen scraps for the compost pile.
- Try to use phosphate-free laundry and dish soaps.
- Avoid the use of household pesticides. Flyswatters work very well.
- Clean your windows with vinegar and water instead of chemical products. Crumpled up newspapers are great for washing windows.
- Hang your clothes out to dry.
- Use washable rags, not paper towels, for cleaning up spills and other household chores.
- Use cloth diapers.
- Use cloth, not paper, napkins.
- Don't use electrical appliances for things you can easily do by hand.
- Re-use brown paper bags to line your trash can instead of plastic liners. Re-use bread bags, butter tubs, etc.
- Use re-usable containers to store food, not plastic wraps and foil.
- Write to companies that send unwanted junk mail. Ask them to take you off their list.
- Take unwanted, re-usable items to a charitable organization or thrift shop.
- Don't leave water running needlessly.
- Turn off the water when you brush your teeth.
- Install a water saving shower head.
- Take shorter showers.
- Set your water heater at 130 degrees.
- Turn the heat down and wear a sweater.
- Turn lights off when you're out of the room.
- Burn only seasoned wood in your stove or fireplace.

50 THINGS YOU CAN DO

IN YOUR CAR

- Drive sensibly...don't waste gas.
- Keep your car tuned up.
- Carpool.
- Ride your bike or walk instead.
- Drive a more efficient car.
- Recycle your engine oil.
- Keep your tires properly inflated to save your tires.
- Don't litter.

WHEN YOU'RE SHOPPING

- Don't buy food or household products in plastic or Styrofoam containers if there is an alternative. They can't be recycled and they don't breakdown in the environment.
- Don't buy "disposable" anything. Paper plates and towels, Styrofoam cups, etc. are extravagant wastes of the world resources.
- If you buy disposables...buy paper products rather than plastics, rather than Styrofoam.
- Buy durable products and keep them longer. Cheap furniture, clothes and appliances often have a short life span.
- Check the energy rating on major appliances.
- Read labels and buy the least toxic product available for cleaning, pest control, etc.
- Put your parcels in one big sack instead of collecting several small ones - or better yet, use a re-usable string or canvas bag. Don't buy things with excess packaging.
- Buy in bulk.
- Ask questions...don't buy products that are hazardous to the environment or that were manufactured at the expense of important animal habitat.
- Buy locally grown food and locally made products when possible to save on transportation costs.

PERSONAL EFFORTS

- Join a conservation organization.
- Volunteer your time to conservations projects.
- Give money to worthy conservation/ environmental causes.
- Check your lifestyle...think about the effects of your daily actions on the environment.
- Read books and articles on wildlife and environmental issues.
- Watch nature programs on T.V.
- Subscribe to conservation or environmental publications. Purchase them as gifts for others.
- Pick up litter along highways and near your home.

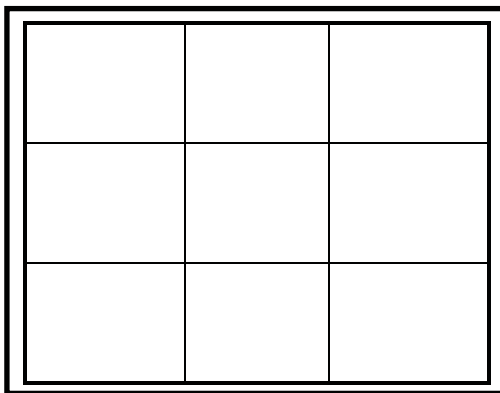
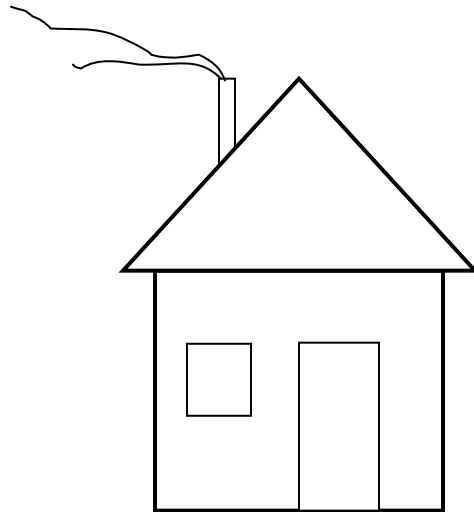
IS YOUR HOUSE DRAFTY?

A house that has leaks around windows and doors will permit heated air to escape and cold air from the outside to enter. About 10% of heating fuel can be wasted because of this. To prevent air from leaking into the house, caulking and weatherstripping can be used around most doorframes and windows.

Have samples of caulking and weather stripping materials handy for students to see.

Make your own draftometer: On a windy day, hold a lit incense stick next to locations of potential air paths to the outside, like windows, doors, electrical boxes, plumbing fixtures, electrical outlets, and ceiling fixtures. If the smoke blows horizontally, you have found an air leak that can use weatherstripping, sealing, or caulking.

Another way to keep cold air from seeping into your house and warm air from escaping is to close the damper on your fireplace or stove when it's not in use.



Check around the edges of windows for drafts.

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BUYING GUIDE FOR ENERGY CONSERVATION

Adapted from Energy Guide for Secondary Home Economics classes

DURATION: 2 periods

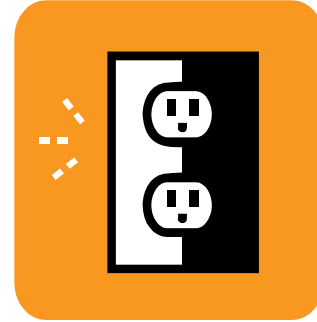
SUBJECTS: Home economics, mathematics, language arts

OBJECTIVES: The student will consider energy conservation choices. The student will learn the cost per kilowatt hour for electricity in his/her own community. The student will compare energy efficiency of two different appliances. The student will list ways to conserve energy with a variety of appliances.

BACKGROUND: With the passage of the Energy Policy and Conservation Act in December of 1975, it became mandatory for appliances to be labeled with energy cost and consumption information. Seven categories of appliances are required to have labels: water heaters, refrigerator freezers, room air conditioners, freezers, furnaces, clothes washers, and dishwashers. Energy Guide labels are an important and invaluable addition for all consumers if they make use of them.

PROCEDURE:

1. Ask students to list ways to conserve energy when using appliances.
2. Pass out Energy Conservation Tips for Appliances and add additional items.
3. Use Thinking About Your Energy Use to help decide on values in energy conservation.
4. Have one student call the electric company to find out costs per kilowatt hour in your area (or use information gathered from the Home and Community Energy Surveys).
5. Introduce the Energy Guide Label and the Comparison Shopping Worksheet.
6. Follow up with a field trip to an appliance store.



MATERIALS:

- Energy Conservation Tips for Appliances
- Thinking About Your Energy Use
- Comparison Shopping
- Blackboard chalk

BUYING GUIDE FOR ENERGY CONSERVATION

REFRIGERATOR/FREEZER:

The most important aspect of refrigeration is the removal of heat. A refrigerator is a means of cooling food below the temperature of the surrounding atmosphere to prevent spoilage from the presence of molds, yeasts, and bacteria. The way refrigeration works is by removing the heat, not by adding cool. Therefore, a trick to conserving energy with your refrigerator/freezer is to remember one thing: cool air isn't blown in; instead, heat is taken out—and the more warm air you let in, the harder your refrigerator or freezer has to work.

Tips for Conserving Energy:

1. Choose a refrigerator/freezer based on the capacity needs of your family. A refrigerator or freezer operates at peak efficiency when filled to capacity but not overfilled.
2. Let hot foods cool to room temperature before putting them in your refrigerator or freezer.
3. Before opening the door, know what you are looking for! Standing there with the door wide open costs money and lots of energy.
4. Open your refrigerator door as few times as possible to prevent heated air from getting inside.
5. If you do not have an automatic defrost unit in your freezer, you should defrost it when the frost gets 1/4 inch thick. The frost acts as an insulator which makes it harder to remove heated air.
6. Turn off your refrigerator when you go on vacation. Plan to use all perishables before you leave.

WATER HEATER:

Conventional water heaters require vast amounts of energy. The water heater is an essential appliance in today's home. The quantities of hot water needed by the family will differ according to:

- habits of the family
- size of the family
- geographic location
- methods of washing clothes and dishes

A water heater is an automatically controlled container for heating and storing water. It is designed to heat water to a temperature of less than 180 degrees. Unless turned off, water heaters operate all day, every day and account for about 22 percent of the household's fuel bills. Water may be heated by various methods, but gas and electric heaters are the most common.

"On-demand" water heaters are now available which only heat water when it's needed. These save large amounts of energy although there is a few minutes delay before the hot water comes on; then there is continual hot water because it's being continually heated.

ENERGY CONSERVATION TIPS FOR APPLIANCES

1. Select a conventional model—or better yet an “on-demand” water heater.
2. Select a well-insulated model.
3. Add a blanket of insulation around your water heater if it is not already well-insulated.
4. The location of the water heater is important if the consumer is to make the most efficient use of this resource. The heater should be located as close as possible to the points of use, and it should be in as warm a place as possible.
5. Set your water heater thermostat at 120 degrees. (If you have an automatic dishwasher, you may have to set the thermostat at 140 degrees for the dishwasher to clean properly).
6. Turn your water heater off or very low when you go on a trip.

CLOTHES WASHER:

A clothes washer uses mechanical agitation and a water solution of soap or detergent to clean clothes. The “compact” washer is one with a tub capacity of less than 16 gallons. Other larger models include all household clothes washers with a tub capacity of 16 gallons or more.

Tips for Conserving Energy:

1. Select a model that can use cold water for rinsing.
2. Consider a model with a variable water fill setting. Minimizing water usage will reduce operating costs.
3. Consider a model with a suds-saver feature if you typically wash 2 or more loads one right after the other.
4. Soak heavily soiled garments instead of washing them twice.
5. Use warm and cold water whenever possible.
6. Operate your clothes washer fully loaded whenever possible.

DISHWASHER:

An automatic dishwasher gives the consumer a convenient effective way to clean dishes, pots, and pans. The principal operation of the automatic dishwasher is the direction of hot water and detergent at high speeds over the dirty dishes. “Compact” dishwashers are countertop models with a capacity of fewer than eight place settings. Larger dishwashers include portable or built-in models with a capacity of eight or more place setting.

Tips for Conserving Energy:

1. Select an appliance with an energy-saver switch that allows natural rather than forced drying of dishware.
2. Consider a model with a short cycle for lightly soiled dishes.
3. Operate your dishwasher fully loaded whenever possible letting the dishes from several meals accumulate before running the dishwasher.
4. Only use the manufacturer recommended detergent. The wrong detergent may cause over sudsing or may not contain germ killing agents that ensure proper cleaning of the dishware.

ENERGY CONSERVATION TIPS FOR APPLIANCES

AIR CONDITIONER:

Air conditioning accounts for a little over 12 percent of the typical American family's total annual electric bill. Air conditioning is the third largest user of electricity in your home after heating and water heating. To save money while staying cool, you should:

Tips for Conserving Energy:

1. Purchase a correctly sized air conditioner with a high energy efficiency rating.
2. Set the cooling thermostat no lower than 78 degrees (You may be asked to raise this temperature in times of energy shortages).
3. Keep the air conditioner's filter clean.
4. Leave storm windows and doors in place year-round.
5. Vent the clothes dryer and range to the outside during the cooling season.
6. Close draperies on the sunny side of the house during the cooling season.
7. Use heat-producing appliances (such as stoves, dishwashers, clothes washers, and clothes dryers) during the cooler parts of the day.
8. Don't block air flow from the air conditioner with drapes or furniture.
9. Place the air conditioner in a window where it will be shaded from the sun.

Alaskans don't need air conditioners—but they are a big energy user in other parts of the country!

FURNACE:

Heating and cooling account for 60 percent of the energy consumed in the home. To heat a home usually requires fuel. The common fuels, called "fossil fuels," are derived from fossils in the ground, and are coal, natural gas, and petroleum. To heat a home, these fuels are either used directly through combustion in the home's furnace, or indirectly, through combustion at a utility plant which then supplies electricity for heating and other purposes. A few homes are beginning to supplement conventional heat sources with solar energy, which helps conserve these scarce, non-renewable fossil fuels.

THINKING ABOUT YOUR ENERGY USE

Reprinted from: Energy Guide for Secondary Home Economics Classes

1. In the spaces below, list 12 major appliances used in your home regularly.

- | | |
|----------|-----------|
| 1. _____ | 7. _____ |
| 2. _____ | 8. _____ |
| 3. _____ | 9. _____ |
| 4. _____ | 10. _____ |
| 5. _____ | 11. _____ |
| 6. _____ | 12. _____ |

2. If there were a law that said you had to use less electricity, **draw a pencil line** through the three items in the list you could do without.

3. **Circle in pencil** the three that really mean the most to you and that you would hold on to until the very end.

4. Now look back over your list and your decisions and consider:

- Why did you decide to do without the three items?
- Why did you want to keep the other three?

5. List below some efficiency steps you can take to reduce the energy and money consumed by each of the three appliances you chose in Question 3.

a.

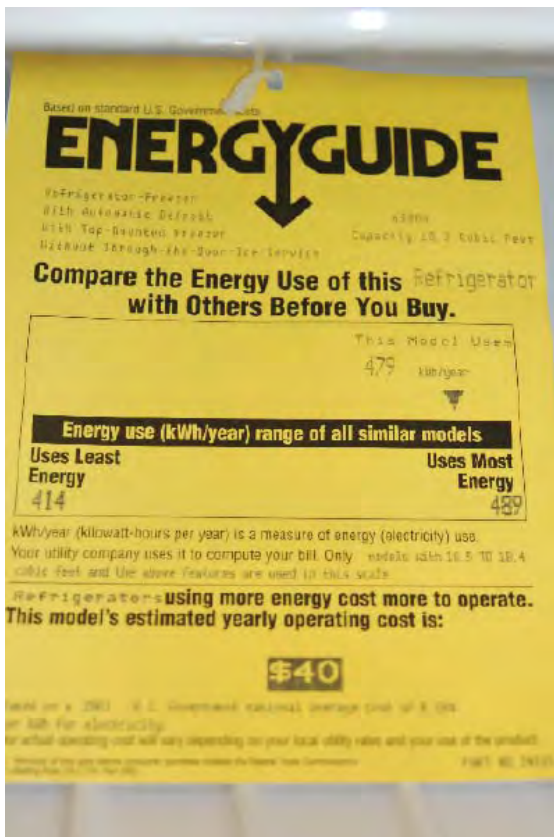
b.

c.

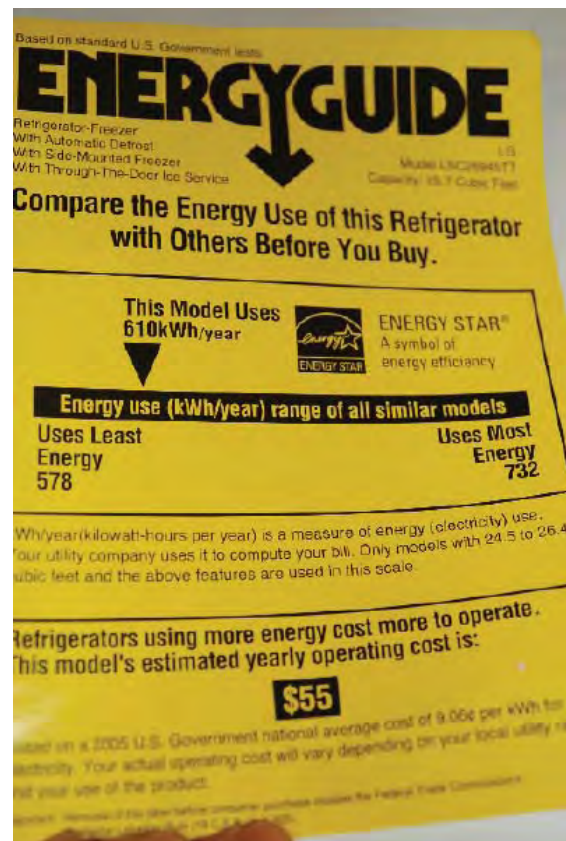
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CASE STUDY IN COMPARISON SHOPPING

One appliance might have a higher purchase price than another but be more energy efficient—or it could cost more initially but not be any more efficient. You have to check all the facts to know for sure which is the better buy in the long run.



Refrigerator 1



Refrigerator 2

Your family needs a new refrigerator. The one you used for years has just stopped working and the cost to repair is too much, considering its age.

When you go to shop for the refrigerator, you find different models and sizes. Refrigerator 1 costs \$1,400, and refrigerator 2 costs \$2,000. Both have a similar yellow label attached to them, with the same information on it (as shown above).

WHICH REFRIGERATOR WOULD YOU BUY? WHY???

CASE STUDY IN COMPARISON SHOPPING

**Model A
Standard Model**

**Model B
Energy-Efficient
Model**

COMPARISON SHOPPING

If you have to choose between two appliances with the same features, capacities, and price, but with different annual energy costs, then obviously you are better off buying the one with the lower annual energy cost (the more energy efficient model). In this case, you can simply look at the big number on each label, see which is lower, and take that model with you. Be careful to compare similar items (are refrigerators 1 and 2 similar? If not, how are they different?).

The purchase price of the energy efficient model may be higher than the price of the standard model. (This is because extra insulation and more efficient motors often cost more). But think again: the lower energy cost of the energy efficient model will usually make up for its higher purchase price. The question, then, is how to figure out which model will cost you less in the long run.

Are the appliances comparable in size and features? _____. To find the capacity of the model, look just below the word "Energy Guide" on the label. The refrigerators in this example are different capacities, and the features given on the top left side of the labels are slightly different, so the answer to the above question is "no."

Step 1. Purchase Price

Step 2. Yearly Cost
(from appliance
label)

Step 3. How many years do you expect to keep it?

Total Operating Cost
(Multiply Yearly Cost by number of years you will keep it).

Step 4. Total Cost to you
(Add Purchase Price and Total Operating Price).

Step 5. To figure how long it will take to recover the extra cost of the energy efficient model, divide the difference in price from line 1 by the difference in yearly operating cost from line 2.

Difference in Purchase Price ÷ Difference in Yearly Cost = Years to Recover.

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RECYCLING

by Elizabeth Trowbridge

SUBJECTS: Social studies, science, art

DURATION: 1-2 periods

BACKGROUND: Waste disposal is a major problem in our country. If we are to live a more energy conscious lifestyle then we need to be aware of energy that we waste when we dispose of trash that could be recycled and produce consumable items that cannot be recycled. Recycling is a concrete way of helping to reduce our trash problem and begin conserving energy. Twenty recycled cans can be made with the energy needed to produce one can using ore. Throwing an aluminum can away instead of recycling wastes as much energy as filling the can half full of gasoline and pouring it out. Each ton of recycled glass saves 9 gallons of fuel oil in the glass production process. Paper made from waste papers instead of virgin wood requires 64% less energy and 61% less water; it also results in 70% fewer air pollutants. It takes 42 gallons of high quality crude oil to produce two and a half quarts of motor oil. It only takes one gallon of waste oil to produce the same amount. Recycling saves resources, saves energy, reduces litter and takes very little time. Also, recycling saves landfill space which is very important in most communities.



MATERIALS:

- Posterboard
- Markers
- Recycling cans/bins
- Plain T-shirts
- Fabric markers or paints
- Directions for tote bag from plastic bags

PROCEDURE:

1. Have students research any local efforts at recycling resources such as aluminum and paper. What are the benefits to the community? Have these efforts created any new jobs or local income? Where are recycling centers or drop offs located? Have a group of students, or the class, write for a brochure describing everything anyone ever wanted to know about recycling.

RECYCLING

2. Have students set up a recycling center at the school or begin a recycling drive at the school. Coordinate this effort with community groups. Advertise by creating posters showing the benefits of recycling and the ugliness of litter. Have recycling drop-off's visible and easily accessible to the students. Make reports of cans, paper, etc. collected in the local and school newspapers. Set a goal and make a chart showing progress. Make this visible to all students.

EXTENSIONS:

Have students design and make T-shirts on new or recycled cloth. The easiest way to do this is to use fabric markers if available in your area.

INSTRUCTIONS - PLASTIC BAG TOTE

FINISHED SIZE: 15 inches high x 16 inches wide not including the straps

NOTE: Do not use hook that you don't want to break or be stained. Your hook may become stained from the bags, so it's not necessary to use a high-quality hook while crocheting with plastic bags.

DIRECTIONS:
with white bags

ch 28

Round 1 - hdc in 2nd ch from hook and in each remaining ch, working around the backside of the ch hdc in each st, join with a sl st to 1st hdc (54 total)

Round 2-5 - ch 1, hdc in each st around, join with a sl st to 1st hdc at the end of round 5 change to yellow bags, do not cut white bags

Round 6-7 ch 1, with yellow bags, hdc in each st around, join with a sl st to 1st hdc, cut yellow bags, at end of round 7 pick up the dropped white bags

Round 8-10 - ch 1, with white, hdc in each st around, join with a sl st to 1st hdc, at end of round 10 change to blue bags, do not cut white bags

Round 11- 13 - ch 1, with blue bags, hdc in each st around, join with a sl st to 1st hdc, cut blue bags, at end of round 13, pick up the dropped white bags

Round 14-20 - ch 1, with white, dc in each st around, join with a sl st to 1st hdc, at end of round 20 change to yellow bags, do not cut white bags

Round 21 - ch 1, with yellow, hdc in each st around, join with a sl st to 1st hdc, cut yellow bags, at end of round 21 change to white bags

Round 22- ch 1, with white hdc in next 7 sts, ch 24, sk 8 sts, hdc in the next 19 sts, ch 24, sk 8 sts, hdc in next 12, join with a sl st to 1st hdc

Round 23 - ch 1, sc in next 6sts, work 28 sc around the next ch 24 sp on last round, sc in next



MATERIALS:

- Numerous plastic grocery bags - white, blue, and yellow
- M hook

INSTRUCTIONS - PLASTIC BAG TOTE

19 sts, work 28 scs around the next ch 24 sp on last round, sc in next 13 sps, join with a sl st in beg sc (94 total)

Round 24 - ch 1, sc in each st around (94 total)

INSTRUCTIONS FOR MAKING THE PLASTIC BAG "YARN"

NOTE: The below instructions are for making the double thick "yarn" using the plastic bags; you will need to use a larger hook when using this method.

1. Lay the bag flat



2. Cut the handles and bottom seam off the bag



3. Fold the bag into a strip



4. Cut the bag into 1 1/2 - 2 inch pieces



5. Connecting the rings: place - one ring over the other



6. Take one end of the white bag and insert it into the other end



7. Pull tightly but not too tight or it will tear. This forms a knot that will not be seen when you crochet. Keep repeating the above and roll up your strips into your new ball of "yarn."

ARCTIC NATIONAL WILDLIFE REFUGE DILEMMAS

by William Ross

SUBJECTS: All

DURATION: Three periods

OBJECTIVES: Students will list, by means of role playing, discussion and issue cards, the issues faced by different groups on concerns of The Arctic National Wildlife Refuge. Students will describe the difficulty in reaching a unilateral agreement in group discussion.



PROCEDURE:

1. Before the issue cards are dealt out, review some of the resource material, such as videos, and newspaper and magazine articles on the Arctic Refuge.

2. Have students summarize, in their journals, their reactions to and questions raised from reviewing the resource materials.

3. List some of the issues readily apparent and discuss. Divide the class into groups (3 students per group). Deal the issue cards to each group of students. The group elects a spokesperson and that person represents the group in discussion and question sessions. Each group reviews their issue card and has to come up with a uniform and effective way to defend their issue. This will involve cooperation and compromise and should be a challenge for the students. Remind groups to use the resources they just reviewed to back-up their arguments. The objective here is to raise issues and not necessarily to solve them. The debate will consist of open ended questions and will not be expected to lead to any conclusions. Each group spokesperson will be expected to defend his particular issue card.

5. Ask students to evaluate other groups based on whether or not they presented the issue with clarity. This evaluation system will simply be a numerical value between 1 and 10.

6. Ask students to write a paper listing the issues covered by the issue cards and highlighting the points of discussion that followed.

EXTENSION:

1. Ask the students to write an essay on the difficulty of reaching a definite conclusion concerning the development of the Arctic Refuge.

MATERIALS:

- Issue cards
- News articles

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ISSUE CARDS

1. A Middle East war has closed the Arabian Gulf preventing transportation of fuel oil to the U.S.A. It is imperative that the oil resources of the Arctic Refuge be developed.

2. You are in favor of putting a sales tax on gasoline, making it twice as expensive as it is now at the gas pump. Advocate that this will reduce gas consumption and leave billions of gas tax dollars available for research on alternative sources of energy.

3. You are living in a developed area of the country surrounded by little, if any, wilderness areas. You feel it is important that wilderness exists even if you never use or see it. It is your belief that the remaining wilderness areas scattered throughout the country (of which the Arctic Refuge is one) should be protected at any cost. You believe that the U.S. economy is able to afford to not develop the Arctic Refuge.

4. As an Alaska Native living a subsistence lifestyle you believe that the summer calving grounds of the caribou will be destroyed by oil development. Your subsistence way of life is being threatened!

5. As an oil company you believe that there has been no ecological impact on the North Slope-Prudhoe Bay oil fields. You feel that lessons that have been learned from this experience, plus advanced technology will even further lessen the impact of oil exploration in the Arctic Refuge.

6. As an environmentalist you can see the terrible impact oil production has had on the North Slope. There is no doubt that the same would happen in the Arctic Refuge, destroying forever the only remaining unspoiled stretch of arctic coastline in the U.S.A.

ISSUE CARDS

7. You are an Alaskan resident and store owner. You depend upon the oil revenues to fuel the economy. Most people who buy your goods work for the state. You would like to see the Arctic Refuge developed in order to ensure a growing economy.

8. North Slope oil production is at an all time low. Unless the oil companies are able to switch operations to the Arctic Refuge, the Alaskan economy will undergo a recession resulting in a huge loss of jobs and massive migration from the state.

9. Since the oil spill of March 24th, 1989, Congress has been reluctant to allow exploration for oil in the Arctic Refuge until the effect of the oil spill in Prince William Sound has been fully documented and researched. However, Congress is being asked to make its decision more quickly because of the huge amount of money involved with the oil companies.

10. You are a Native stockholder living in the North Slope Borough. Oil revenues provide corporate revenues which supply services and benefits to shareholders. Benefits come mostly in the form of dividend checks. You support the development of the Arctic Refuge because of the potential for economic growth in your community.