LESSON 12

Plastic Trash and Wildlife

Major Concept

The introduction of unnatural substances in the environment by people can do great harm to wildlife.

Objectives

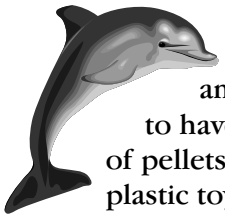
As a result of this activity students will be able to describe:

1. the negative effects of plastic solid waste on wildlife; and

2. what each person can do to avoid adding to this problem.

Background

Since the early 1970s, the amount of plastic in the marine environment has increased dramatically. Plastic negatively affects wildlife in a number of ways. Some animals mistake plastic for food to eat. For example, sea birds are known to have eaten plastic in the form of pellets, bits of polystyrene, even plastic toy soldiers. In addition, sea turtles, apparently regarding plastic bags as jellyfish upon which they regularly feed, have been found with balls of plastic in their stomachs. (One such ball, when unraveled, measured 9 feet wide and 12 feet long.) Other animals found to have eaten plastic in one form or another are: whales, dolphins, bottom fish, a manatee, sea snails and worms, and plankton. Another damaging effect of plastic trash on wildlife is the entanglement of animals in everything from six-pack holders to plastic rings, discarded fishing line and nets. Plastic debris is responsible for the death of 100,000 marine mammals. "Some government officials estimate that about 50,000 northern fur seals currently die in North Pacific waters each year as a result of entanglement in fishing gear. In 1975, the National Academy of Sciences estimated that commercial fishing fleets alone dumped more that 52 million pounds of plastic packaging material into the sea and lost approximately



Grades:
Intermediate - Secondary.

Subject:
Social Studies, Science, Language Arts.

Time:
One or two class periods.

Materials:
The article Plastic at Sea from Natural History Magazine 2/83.

298 million pounds of plastic fishing gear, including nets, lines, and buoys" (Plastics at Sea).

Procedure

1. Have each student bring to class any plastic litter found near his/her house.

2. Discuss: What non-renewable natural resource is plastic made from? (petroleum) What uses other than making plastics can you think of for this resource? (Referring to the collected plastic litter.)

   Inquire: What other material or container could have been used in place of this piece of plastic? Why is plastic litter even more of a problem than many other kinds of litter? Where did all this plastic come from? Why do people litter? Do you litter?

3. Have students make a list of the wildlife commonly found in the area where the plastic clutter and trash were recorded or collected.

   Ask: How will this plastic affect the wildlife we have listed? In what ways might this plastic litter endanger wildlife? Show accompanying pictures and share some of the information from Teacher Background.

   Ask: Why is so much material that harms wildlife manufactured? What can each of you do to lessen the negative impact of plastic trash on wildlife?

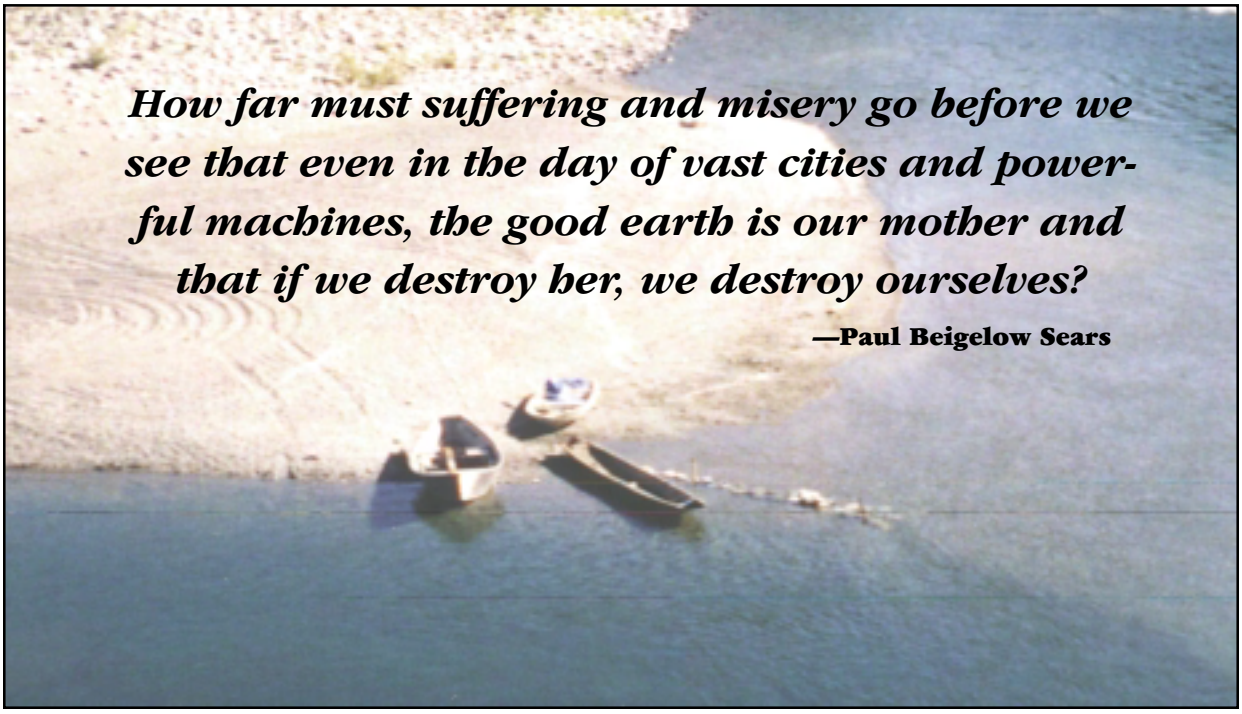
Discussion

From what nonrenewable natural resource is plastic made from?

Why is plastic litter even more of a problem than other kinds of litter?

In what ways does plastic waste and litter endanger wildlife?

Adapted from P*roject WILD*, 1986.



Plastics at Sea

by D.H.S.Wehle & Felicia C. Colernan

Throughout the 1970s, a number of biologists studying the feeding habits of sea birds in different oceans of the world recounted the same story the birds were eating plastic. Similar reports of plastic ingestion and of entanglement in plastic debris began to surface for other marine animals off southern New England, turtles off Costa Rica and Japan, whales in the North Atlantic. At the same time, plastic particles turned up in surface plankton samples from both the Atlantic and Pacific oceans; plastic debris was retrieved by benthic trawls in the Bering Sea and Britain's Bristol Channel; and plastic pellets washed ashore in New Zealand in such large numbers that some beaches were literally covered with "plastic sand." By the close of the decade, marine scientists around the world had become aware of a new problem of increasing ecological concern-plastics at sea.

Two forms of plastic exist in the marine environment, "manufactured" and "raw." Manufactured plastic material along beaches and adrift at sea is primarily refuse from transport, fishing, and recreational vessels. In 1975, the National Academy of Sciences estimated that commercial fishing fleets alone dumped more than 52 million pounds of plastic packaging material into the sea and lost approximately 298 million pounds of plastic fishing gear, including nets, lines and buoys. Raw plastic particles-spherules, nibs, cylinders, beads, pills, and pellets - are the materials from which products are manufactured. These particles, about the size of the head at a wooden match, enter the ocean via inland waterways and out fallstorm plants that manufacture plastic. They are also commonly lost from ships, particularly in the loading and unloading of freighters. Occasionally, large quantities are deliberately dumped into the sea.

Much of what we know about the distribution patterns and abundance of raw plastic in the world's oceans comes from plankton sampling of surface waters.

Inevitably, many animals foraging in the marine environment will encounter and occasionally ingest these widely distributed plastic materials. Sea birds choose a wide array of plastic objects while foraging: raw particles, fragments of processed products, detergent bottle caps, polyethylene bags, and toy soldiers, cars, and animals. Marine turtles on the other hand, consistently select one item—plastic bags. In the past few years, plastic bags have been found in the stomachs of marine turtles. Polystyrene spherules have been found in the digestive tracts of one species

of chaetognath (transparent, worm like animals) and eight species of fish in southern New England waters. They have also turned up in sea snails and in several species of bottom-dwelling fishes in the Several Estuary of southwestern Great Britain.

Marine mammals are not exempt from participation in the plastic feast. Stomachs of a number of beached pygmy sperm whales and rough-toothed dolphins, a Cuvier's beaked whale, and a West Indian manatee contained plastic sheeting or bags. In addition, Minke whales have been sighted eating plastic debris thrown from commercial fishing vessels. Curiously, plastic has not been found in any of the thousands of fur seal stomachs examined from Alaska.

The obvious question arising from these reports is, why do marine animals eat plastic? In the most comprehensive study to date, Robert H. Day of the University of Alaska maintains that the ultimate reason for plastic ingestion by Alaskan sea birds lies in plastic's similarity in color, size, and shape to natural prey items. In parakeet auklets examined by Day, for example, 94 percent at all the ingested plastic particles were small, light brown, and bore a striking resemblance to the small crustaceans on which the birds typically feed.

Marine turtles also mistake plastic objects for potential food items. Transparent polyethylene bags apparently evoke the same feeding response in sea turtles as do jellyfish.

Sea birds, marine turtles, and marine mammals all eat plastic. Perhaps ingesting plastic is inconsequential to their health. After all, cows are known to retain nails, metal staples, and strands of barbed wire in their stomachs for more than a year with no ill effects. For marine animals, however, the evidence is growing that in some cases at least, ingested plastic causes intestinal blockage. George R.Hughes of the National Parks Board, South Africa, extracted a ball of plastic from the gut off an emaciated leather back turtle; when unraveled, the plastic measured nine feet wide and twelve feet long. There is little doubt that the plastic presented an obstruction to normal digestion.

The 20 dead birds discovered on a beach in southern California, all with plastic in their digestive tracts, presents less clear case. Did the birds suffer an adverse physiological response after eating plastic or were they already under stress because of a reduced food supply and eating the plastic in a last-ditch effort to prevent starvation? The same question applies to other instances of emaciated animals that have eaten plastic. At this time, we don't have an answer.

We do know that plastic is virtually indigestible and that individual pieces may persist and accumulate in the gut. Ingested plastic may reduce an animal's sensation of hunger and thus inhibit feeding activity. This, in turn, could result in low fat reserves and an inability to meet the in-

creased energy demands of reproduction and migration. Plastic may also cause ulcerations in the stomach and intestinal linings, and it is suspected at causing damage to other anatomical structures. Finally, ingestion of plastic may contribute synthetic chemicals to body tissues. Some plasticizers, for example, may concentrate in fatty tissues, their toxic ingredients causing eggshell thinning, aberrant behavior, or tissue damage. When highly contaminated tissues are mobilized, these toxins may be released in lethal doses.

A more obvious effect of plastic pollution is the aesthetic one. Whether we venture deep into the woods, high atop a mountain, or out on the ocean to escape the trappings of civilization, our experience of the natural world is often marred by the discovery of human litter. Even more disturbing to the spirit is the sight of a young pelican dangling helplessly from its nest by a fishing line, a whale rising to the surface with its flukes enshrouded in netting, or a seal nursing wounds caused by a plastic band that has cut into its flesh. Unfortunately, such observations are becoming more and more common, another consequence of plastics at sea.

During the last 20 years, fishing pressure has increased dramatically in all the world's oceans, and with it, the amount of fishing-related debris dumped into the sea. In addition, the kind of fishing equipment finding its way into the ocean has changed. Traditionally, fishing nets were made of hemp, cotton, or flax, which sank if not buoyed up. These materials disintegrated within a relatively short time and, because of the size of the fibers, were largely avoided by diving sea birds and marine mammals. With the advent of synthetic fibers after World War II, however, different kinds at nets came into use. These new nets were more buoyant and longer-lived than their predecessors, and some of them were nearly invisible under water.

The result of these changes in net materials has been a tragic increase in mortality of air-breathing animals. Incidental catch refers to nontarget animals that are accidentally caught in an actively working net. Another kind of net-related mortality is known as entanglement and relates to any animal caught in a net that has been lost or discarded at sea. Unlike working nets, which fish for specific periods of time, these free-floating nets, often broken into fragments, fish indefinitely. When washed ashore they may also threaten land birds and mammals; in the Aleutian Islands, for example, a reindeer became entangled in a Japanese gill net.

Plastic strapping bands - used to secure crates, bundles of netting. and other cargo, are another common form of ship-generated debris. Discarded bands are often found girdling marine mammals, which are particularly susceptible to entanglement because at their proclivity for examining floating objects.

Sea birds that frequent recreational waters or coastal dumps are also subject to ringing by the plastic yokes used in packaging six-packs of beer and soda pop. Gulls with rings caught around their necks are sometimes strangled when the free end at the yoke snags on protruding objects. Similarly, pelicans, which plunge into the water to feed, run the risk of diving into yokes. If the rings become firmly wedged around their bills, the birds may starve.

Not all encounters with plastic prove harmful to marine organisms. Some animals are incorporating the new material into their lives. Algae, marine worms, and small crustaceans attach to plastic floating at sea; bacteria proliferate in both raw and processed plastic refuse.

Plastic provides these organisms with long lived substrates for attachment and transport; in some cases, hitching a ride on floating pieces of plastic may alter an organism's normal distribution.

Several species of tube-dwelling polychaetes construct the tubes of raw plastic particles present in benthic sediments. Marine birds all over the world incorporate plastic litter into their nests, but in this case, the use of plastic may be harmful because chicks can become entangled in the debris and die.

Instances of marine animals adapting to this new element in their environments do not alter the predominantly negative effect of plastics at sea. The problem is global and its solution will require international cooperation. Historically, the high seas have, in many respects, been considered an international no-man's land. Recently. however perception of the ocean as a finite and shared resource has caused many nations to express concern for its well-being.

LESSON 13

The Waste Stream

Major Concept

Personal responsibility can reduce the amount of waste generated.

Objectives

As a result of this activity students will be able to demonstrate the ability to:

1. collect and tabulate data to determine the class's contribution to the waste stream and;

2. consider how their personal waste compares with national statistics.

Grades:
Intermediate - Secondary.

Subject:
Social Studies, Mathematics.

Time:
3 - 4 class periods.

Materials:
Student worksheet; large plastic garbage bags; disposable plastic gloves or rubber gloves for each student; tongs (one pair for every 2 students); plastic drop cloths or old plastic table cloths; scale; and graph paper.

Background

When assessing the life cycle of a consumer product, it is increasingly important to consider the amount of solid waste generated in each phase of its life cycle and the disposal of that waste. The Environmental Protection Agency (EPA) supports a four-tiered integrated approach to managing the garbage America generates. That approach, in priority order, involves:

1. Source Reduction, decrease the total amount or toxicity of waste people create;

2. Recycling and Composting, reuse a major portion of the valuable resources in our waste which will further reduce the amount of waste going to landfills and incinerators;

3. Waste Combustion, burn waste which will reduce the volume of municipal waste by up to 90 percent, with the added benefit of recovering energy; and

Use it up,
wear it out,
make it do,
or do without.
—New England Maxim

4. dispose of those materials that cannot be recycled, composted or safely incinerated, or for the material that is left over after garbage is incinerated in a carefully constructed landfill.

Source Reduction

In life cycle assessment, source reduction means minimizing the amount of waste generated at each stage of a product's life. This includes designing products and packaging requiring less raw material in the manufacturing process. For example, concentrated and multifunction products eliminate or reduce the need for separate purchases of several single-purpose products. Larger sizes of products; and refillable packages help decrease the amount of packing waste that is generated. Removal of heavy metal-based inks and dyes from packaging permits safe incineration in those communities with this waste-handling method.

"Currently, the national recycling rate for solid waste in the U.S. is just 24%."

Recycling and Composing

Several years ago, the EPA established a national recycling goal of 40 percent by the year 1995. Certain materials, such as aluminum beverage containers, have dramatically exceeded these goals.

With extremely high value as scrap materials, PET plastic and aluminum are reprocessed to make more beverage containers and many other items, from insulation to carpeting, saving natural resources and significantly reducing the high energy demands to process products from "virgin" materials. A study of beverage packaging systems has also shown that the use of recycled rather than virgin materials significantly lowered environmental stress.

While recycling is a way to recover valuable nonorganized material, composting is a natural form of recycling in which organic wastes are converted to a rich humus of mulch through a natural decaying process. It is estimated that as much as 70 percent of a community's solid waste such as food and yard clippings is organic and, therefore, compostable. Composting needs to be combined with materials separation and recovery processes to recover recyclables and to remove undesirable contaminants from ending up on the finished compost.

Since few new landfills are being sited and permitted and the capacity of our current landfills is rapidly diminishing, composting may be a natural alternative for handling large volumes of waste in many communities.

Where would we put large-scale community composting facilities? Some suggest that locating them directly on top of existing or closed landfills might be appropriate. Ideally, composting facilities are designed to handle only organic waste, and therefore such facilities do not pose the same health or environmental concerns that landfills do.

Waste-to-Energy (WTE) can be thought of as thermal recycling. The ideal WTE system couples combustion technology with recycling operations to recover all valuable scrap materials

and to remove any potentially unsafe materials prior to combustion. This step also raises the facility's operating efficiency by removing noncombustibles that may otherwise lower furnace temperatures.

When nonrecyclable waste is burned in a WTE facility, the garbage is converted to heat and captured as useful energy that can be used to provide electricity to operate the rest of the facility or used to power homes or businesses.

Many communities object to constructing combustion facilities in or near their area, citing concerns about air quality.

Landfills

Currently about 61 percent of our solid waste is landfilled. While technologies exist to ensure the environmentally safe site selection, design, operation and closure of landfills, only a small percentage of today's 3500 operating municipal landfills meet these optimum criteria. By the mid-1990s, an estimated 50 percent of our landfills will be forced to close either because they have reached their volume capacity or because they fail to meet environmental standards.

This is likely to occur first in densely populated urban areas where large volumes of waste place heavy demand on existing landfills and other solid waste disposal systems. Combined with scarce land, public resistance to certain waste management systems, the NIMBY syndrome (Not In My Back Yard) and genuine environmental concerns, many communities have limited waste management options that they can consider.

In the meantime, as landfills reach capacity and as these communities work to put into place new, long-term alternative waste handling and disposal methods, they must rely on short-term disposal options that may include sending garbage to "host" states—those with available landfill space or those that have waste combustion facilities. For many communities, the fees collected for accepting garbage from other communities help to offset operating costs.

Even with source reduction, recycling, composting and incineration, the EPA acknowledges that landfills must remain an essential part of comprehensive solid waste management, particularly for nonrecyclables, for materials that cannot be incinerated and for the safe disposal of incineration ash.

Introduction

Students have considerable control over how much waste they each generate through the product choices they make and how they use the product.This activity can be implemented in one of two ways. Select the option that best suits the maturity level of your students and meets the cooperation level of your school's administration and other faculty members.

Procedure

Explain to your students that they will be conducting a "field experiment" to see how the class as a "community" stacks up against the national average in their discards.

OPTION A

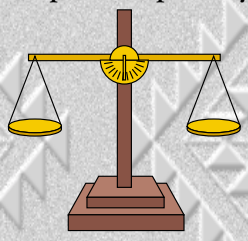
1. Have students keep a "Throw-away Journal" in which they will record every item they discard for one full day. Stress the importance of keeping a scrupulously accurate record. Tell students that their data will be pooled and analyzed at the conclusion of the activity. If Option A is used, the percentage calculation for the characterization of the class's solid waste will have to be modified and based on the total number of items the class disards rather than on total weight, as in Option B.

OPTION B

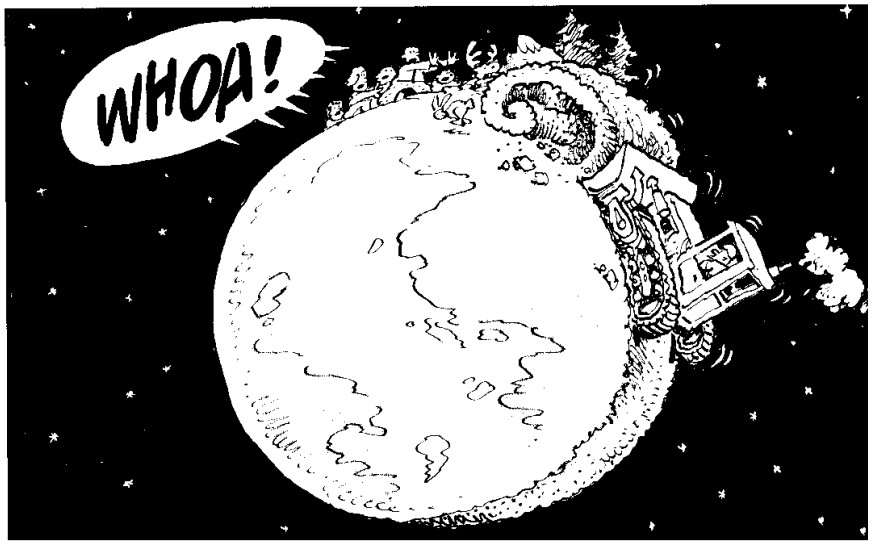
DAY 1:
Students carry a large plastic garbage bag with them for one full day in which their discards (for sanitary reasons, food waste and personal hygiene products should be excluded) are deposited. However, as the activity progresses, it is important to talk about food waste.

DAY 2:
Students weigh their bags of garbage and calculate a class garbage weight total. Then, in a place you have prearranged with the school administration and maintenance staff, spread out large plastic dropcloths on which students will sort their garbage by category (plastic, glass, metal, paper, textiles, misc.). Be sure to include a recycling pile for items that are intended for recycling.

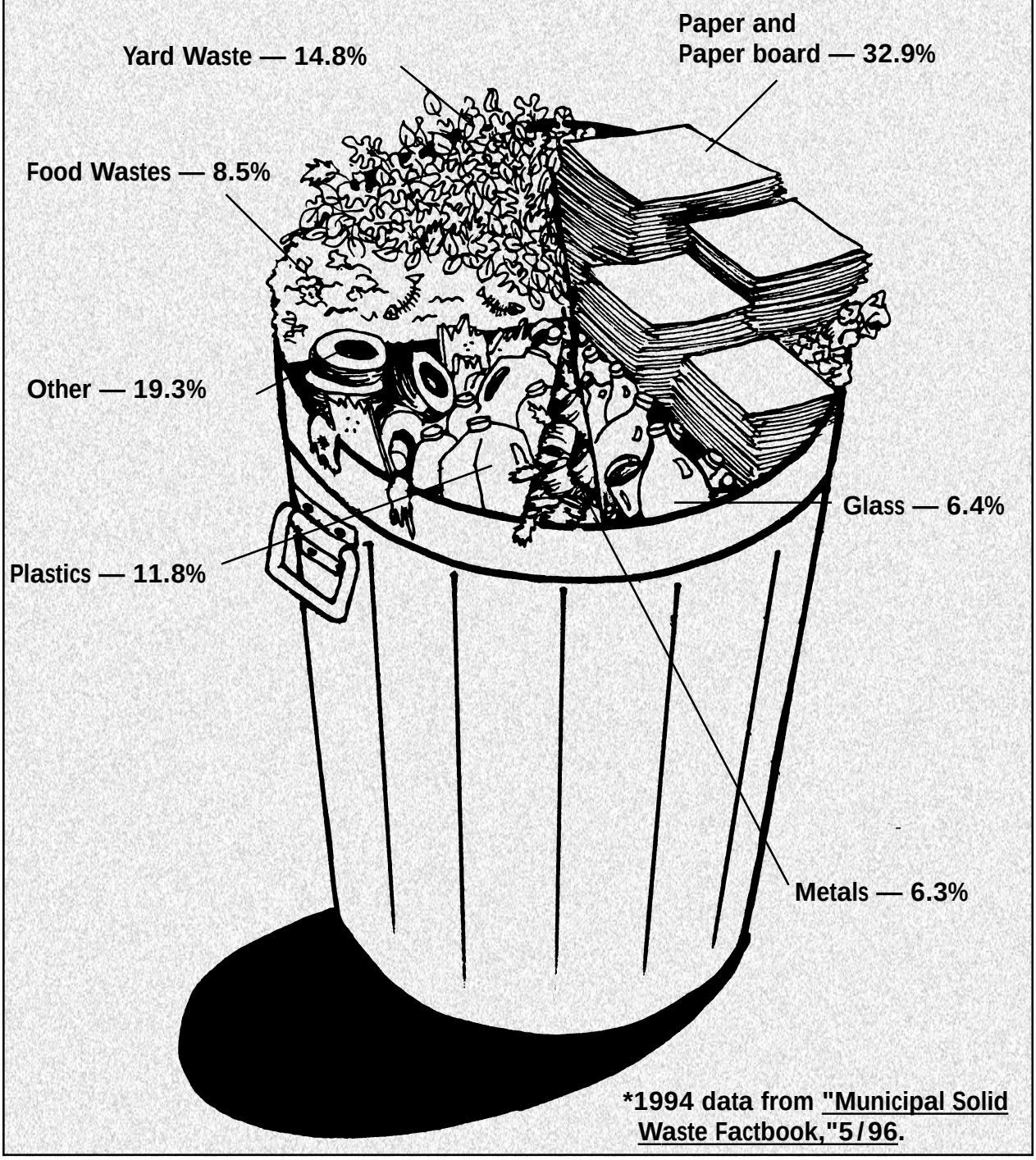
Weight the garbage for each category and determine that category's percent of the class's total waste stream as well as its recycling rate. How much garbage does each person in the class generate, on the average? (The national average is 4 pounds per day!)



DAY 3:
Chart the results of the data collected. (Have students develop pie charts of their results for homework.) How do these results compare with the national statistics? Use the overhead transparency master, "What's In The Garbage?" to show students how the class stacks up against the national average.



Materials Discarded into the Municipal Waste Stream



*1994 data from "Municipal Solid Waste Factbook,"5/96.

LESSON 14

Waste Dilemma

Major Concept

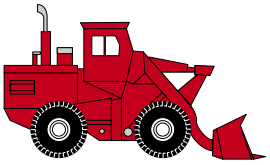
Improving the environment with better waste management.

Objective

As a result of this activity students will be able to read research and make a recommendation for their tribe's long-range solid waste disposal plan.

Background

Managing waste becomes a civics lesson in this library research and group dynamics exercise when students role-play members of a solid waste task force. Each task force is assigned a disposal option. The task force will evaluate the disposal option it has for the tribe's solid waste management plan. The task forces research each of these options and the conditions under which they are most appropriate and present their recommendations at a tribal council meeting for a vote.



Grades:
Intermediate - Secondary.

Subject:
Social Studies.

Time:
Two class periods.

Procedure

1. Re-introduce the EPA's 3-tiered approach to solid waste management as presented in "The Waste Stream".

2. Provide the Problem Sheet to each group "Task Force."

3. Stage a tribal council meeting in which the council makes a recommendation to the tribe. Allow tribal members to pose questions to the tribal council members, during which the tribal council must explain and defend their recommendations.

4. Then, have the class "vote" on the solid waste plan the tribal council proposed for its tribe.

STUDENT PROBLEM SHEET

The dumps have become a drag. Open dumps line the road to Pecwan and can be seen from the Klamath. The dumps are not only ugly but have become a health hazard. Additionally, litter and other forms of trash is left on roadsides and throughout the reservation. The primary reasons people leave their waste where they do is the inconvenience and cost of taking waste to an established disposal site,out of habit.

The tribe is faced with a dilemma, how to adequately dispose of solid waste before it causes more health hazard and becomes even more unsightly. Given the remote aspect of the reservation few options exist. It appears that treatment and disposal must take place on tribal land. But what is the best method?

In an effort to solve the problem the tribal council has appointed four task force groups to investigate options available. The task force groups are to make a recommendation before the tribal council. The tribal council will select one of the recommendations.

Tribal Council

The decision rests with you. It is up to you to recognize your own special interests and the interests at each group making statements before the Council. Consider these questions:

1. What criteria are you going to use to analyze the statements made by the citizens? Make a list of these.

2. What are the advantages and disadvantages of each recommendation? What other options could you consider?

3. Is there room for compromise in reaching a decision? If so, do you think citizens will be willing to make compromises? In what way? What compromises can you offer them?

You can ask questions of each group after its three minute presentation. When all groups have completed their presentations, consider alternatives open to you. You may consider other solutions as well. The recommendation the council chooses must be acceptable to the majority of the council members.

TASK FORCE

Transporting Waste Task Force Group

Trucking waste off the reservation is currently being done. All collected waste is now taken to the Cummings Road Landfill outside Eureka. The problem that needs to be overcome is the inadequate service presently available to collect the trash from tribal members. If an acceptable system of trash collection is to be developed it will cost hundreds of thousands of dollars. Who will pay the cost? All things considered, you feel that transporting the waste off tribal land is the best alternative. The tribe would not have to deal with the expense or health and safety requirements associated with proper solid waste management.

TASK FORCE

Recycling and Composing Task Force Group

Several years ago, the EPA established a national recycling goal of 25 percent by the year 1992. By 1996, that rate increased to 40 percent. Currently, the national recycling rate for solid waste in the U.S. is just 23.6 percent. Certain materials, such as PET plastic soft drink containers and aluminum beverage containers, have dramatically exceeded these goals.

Aluminum is reprocessed to make more beverage containers and many other items, from insulation to carpeting, saving natural resources and significantly reducing the high energy demands to process products from "virgin" materials. A study of beverage packaging systems has also shown that the use of recycled rather than virgin materials significantly lowered environmental stress.

While recycling is a way to recover valuable non organized material, composting is a natural form of recycling in which organic wastes are converted to a rich humus of mulch through a natural decaying process. It is estimated that as much as 60 percent of a community's solid waste such as food and yard clippings is organic and, therefore, able to be composted. Composting needs to be combined with materials separation and recovery processes to recover recyclables and to remove undesirable contaminants from ending up on the finished compost.

Since few new landfills are being sited and permitted composting may be a natural alternative for handling large volumes of waste in many communities.

Where would we put large-scale community composting facilities? Some suggest that locating them directly on top of existing or closed landfills might be appropriate. Ideally, composting facilities are designed to handle only organic waste, and therefore such facilities do not pose the same health or environmental concerns that landfills do.

Waste-to-Energy Task Force Group

Waste-to-Energy (WTE) can be thought of as thermal recycling. The ideal WTE system couples combustion technology with recycling and landfilling operations to recover all valuable scrap materials and to remove any environmentally hazardous materials prior to combustion. This step also raises the facility's operating efficiency by removing noncombustibles that may otherwise lower furnace temperatures.

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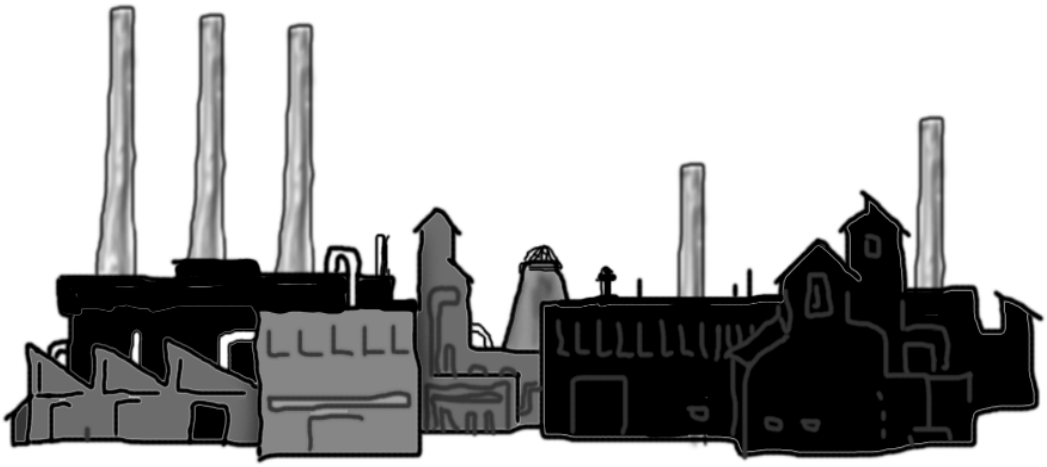

Sanitary Landfill Task Force Group

Sanitary Landfill Task Force Group

Even with source reduction, recycling, composting and incineration, the EPA acknowledges that landfills must remain an essential part of comprehensive solid waste management, particularly for non recyclables, for materials that cannot be incinerated.

Currently about 80 percent of our solid waste is land filled. While technologies exist to ensure the environmentally safe site selection, design, operation and closure of landfills, only a small percentage of today's 3,500 operating municipal landfills meet these optimum criteria. By 2000, an estimated 50 percent of our landfills will be forced to close either because they have reached their volume capacity or because they fail to meet environmental standards.

This is likely to occur first in densely populated urban areas where large volumes of waste place heavy demand on existing landfills and other solid waste disposal systems. Combined with scarce land, public resistance to certain waste management systems, the NIMBY syndrome (Not In My Back Yard) and genuine environmental concerns, many communities have limited waste management options that they can consider.

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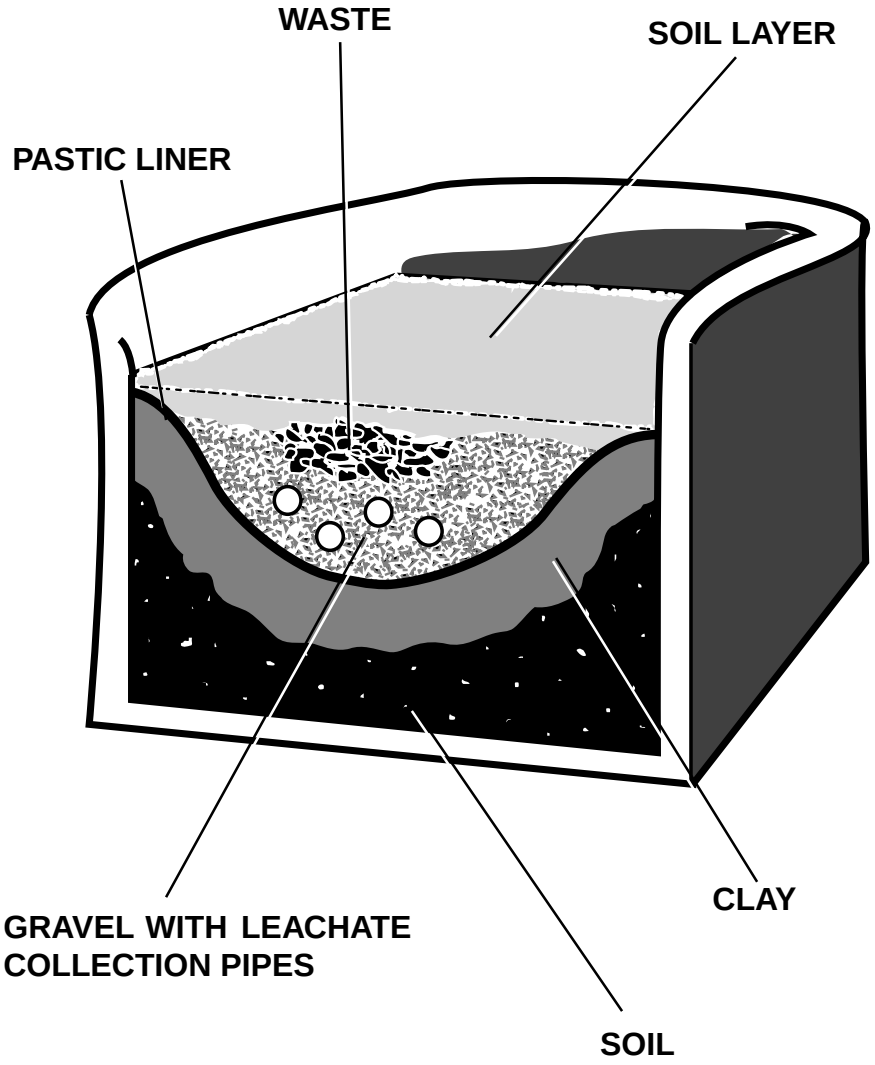
“Bathtub” Model of Modern Sanitary Landfill



*From "Let's Reduce and Recycle; A curriculum for Solid Waste Awareness,"8/90

LESSON 15

Future Trash

Grades:
Secondary.

Subject:
Social Studies, Science.

Time:
Five class periods.

Materials:
Access to a telephone.

Major Concept

Solid waste disposal policies involve diverse community agencies and planning.

Objective

As a result of this activity students will be able to demonstrate the ability to evaluate both current solid waste disposal practices and future plans in their community.

Procedure

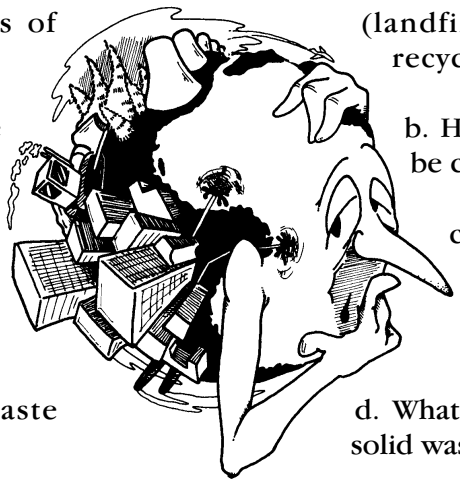
1. Contact tribal representatives, county environmental health officers, state agencies, and planning officials. Find out the following as it applies to your tribe:

   a. Quantities and types of materials discarded.

   b. Where materials are finally disposed.

   c. Quantities and types of materials recycled, reused, and recovered.

   d. Expense at solid waste disposal.



2. Determine your tribe's plans for future solid waste disposal by asking:

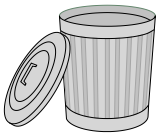
   a. How and where will solid waste be handled/disposed of in the future (landfills, energy production, recycling, etc.)?

   b. How will future disposal sites be chosen?

   c. What quantities of solid wastes will be generated in the future (more or less than present)?

   d. What will happen to the cost of solid waste disposal in the future?

3. Evaluate your findings regarding your community's plans for solid waste disposal:



   a. From your perceptions of the solid waste disposal situations, at the present and in the future, do you feel that your community has made adequate preparations for the future?

   b. If you had the ability to change any aspects of the plan for future solid waste disposal in your community, what would you do?

   c. From your research, make recommendations on how individuals in your community might become involved in determining future courses of action regarding solid waste disposal.

   d. What individual action might you take to alleviate the problem of solid waste in your community?

Adapted from *The No Waste Anthology,* California Department of Toxic Substances Control, 1991.

Resources to Contact

County Waste Prevention Coordinator

Local Garbage Company

State Integrated Waste Management Board

State Integrated Waste Management

County Planning Land Use Division

Environmental Division of Humboldt County Health

LESSON 16

Take a Bite of the Finite

Major Concept

Policies on the use of natural resources are international industrial/economic issues. Nations and intermediate groups of people need to work together to reach solutions and make decisions that are healthy for our global environment.

Objective

As a result of this activity students will be able to demonstrate an understanding that some resources, including resources lost in landfills, are finite.

Grades:
Secondary.

Subject:
Social Studies, Mathematics.

Time:
One class period.

Materials:
Beads of various colors: blue, red, purple, green, yellow, orange.

Background

The numbers of beads reflect a mineral's relative, estimated total abundance — not the mineral's ease of extraction or potential availability.

We can only change the world by changing men.
— Charles Wells

Procedure

Hide one or two differently colored beads to represent rare strategic metals such as chromium and titanium. Divide students into countries:

1. two superpowers (such as U.S. and the Russia), 3 students to a country;

2. two small industrialized countries (such as Japan and Sweden), 1 student each;

3. four developing, third world countries (such as Brazil, India, Zimbabwe), 4 students each.

The number of countries can be changed but the relative numbers should be kept the same. The idea is to reflect the world's unequal distribution of population and resources.

Have students consider the implication of the fact that some rare strategic minerals may be found in countries controlled by hostile or repressive governments.

Have students explore the possibilities of what to do about local shortages of resources. Possible solutions include: recycling, conservation, trading, treaties, etc.

Given the ideas outlined in this activity, have students develop their own learning activity or game.

Version One

1. Select beads of different colors to represent resources that often end up as wastes.

2. Scatter beads throughout the classroom and have students divide into teams representing countries. (Make sure some of the beads are hidden so well that they will not be immediately found.)

3. Give teams time intervals of three minutes, one minute, and 30 seconds to explore for resources.

   a. After each exploration, students are to separate and categorize beads.

   b. Discuss the greater difficulty in finding resources during the second and third period of exploration.

   c. Is competition for resources emerging between countries? Think of examples.

4. What can you do to extend the life of finite resources? What are the advantages of extending the life of resources? (More resources available in the future, lessening of international conflict.)

Version Two

Hide beads throughout the room keeping the colors in large groups to represent concentrated ore deposits. Hide some beads very well.

Discussion

1. How does competition for natural resources contribute to international tension?

2. What is the relationship of competition for resources and war?

3. How do nations try to control finite natural resources?

4. What happens when nations try to control the supply of finite natural resources?

Adapted from *A-Way With Waste,* Washington State Department of Ecology, 1993.

LESSON 17

Redwood Rancheria

Major Concept

Land use decisions are made best when all interested members of the community are involved in the process.

Objectives

As a result of this session, each student should be able to :

1. name and describe at least 10 important types of information needed before making a land management decision;

2. identify cause and effect relationships that exist in environmental management; and

3. describe alternative solutions to solving a specific problem.

Background

We need a variety of information before we can intelligently make land management decisions. Therefore, we must use the whole community as a classroom and learning environment to collect the required information.

Grades:
Secondary.

Subject:
Social Studies.

Time:
2 - 3 class periods.

Materials:
Newsprint or butcher paper, markers in several colors, masking tape, and task cards.

Procedure

Set the stage for this investigation by reviewing what will take place. For example, "During this activity, we will participate in a simulation concerning land use on a hypothetical reservation, and analyze what we have done."

1. Distribute Task Card A. Read the problem to the group and then have them read the given information on Task A and list possible uses of the land to meet the reservations needs.

2. The problem is to identify some possible uses for the 1 square mile (640 acres) of land that has been added to the reservation.

Background Information Sheet For

TASK A (individuals)

"One Square mile (640 acres) of unused county farmland, adjacent to the Rancheria, is now available for use."

Read the background information for Redwood Rancheria, and then list some possible uses of this new addition of land.

Redwood Rancheria

The population is 7,000 and expanding. The expanding population growth is accompanied by demands for more housing, more jobs, additional services (sewage, power, water, garbage, transportation, etc.) and recreational areas.

Resources for industrial development such as power, water, and public transportation are in short supply.

The 640 acre addition was previously used for cattle grazing. There is a small stream and some standing timber (200 acres) of sparsely stocked live oak trees.

The Pipe River is relatively unpolluted and is the source of irrigation water for regional agriculture and the water source of several large communities. The river has several salmon runs and some resident trout. The gravel bed of the river is appropriate raw materiel for concrete manufacture.

The present sewage treatment plant and garbage disposal area are at maximum capacity.

Most members of the rancheria are concerned about the maintenance of a scenic regional environment. The tribal council is the authority for land use, and many citizens groups are being formed to influence their decisions.

List of possible uses for the land.

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Questions and Discussion

After most of the students have started to write down uses on Task A, go ahead with question 1.

1. "What are some possible uses for this addition to the rancheria?" As students respond, write all comments just as they are said. Instead of paraphrasing if they are too wordy, ask: "How shall I write that on the chart?" List all suggestions, specific or general. Number the items as you go along, to simplify identification later. When you feel that you have enough material, go on to question 2.

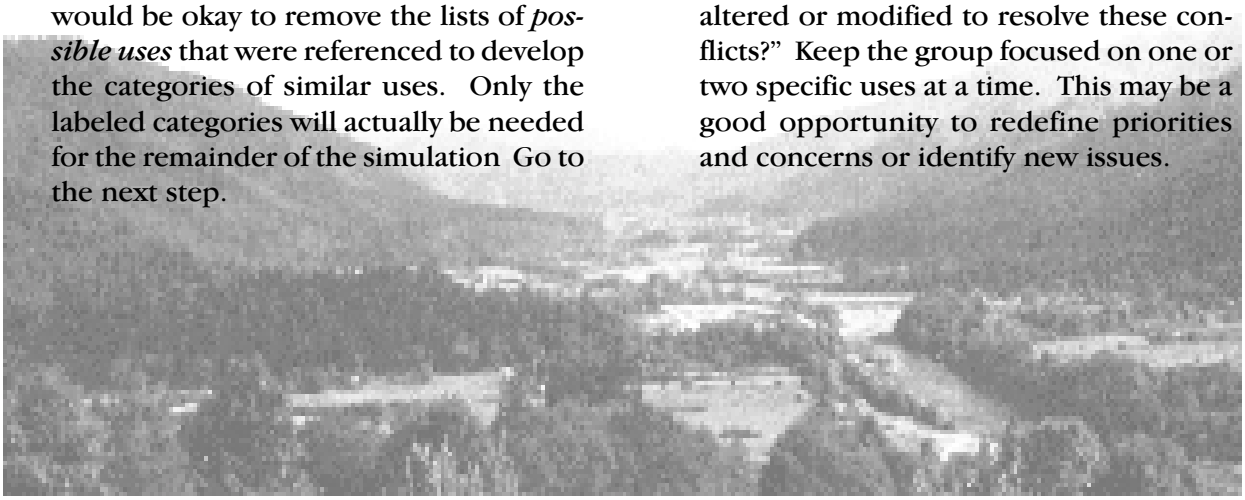
2. "Which of these possible uses are similar?" Designate similar uses by letters, symbols, or colors. When most are designated, or the group seems to run out of thoughts, *stop*. Change items among categories if the participants change their minds. Do not get bogged down in the details of grouping. For example, if some people think one use should be in another category, then put that use in both categories and go on to the next step.

3. "What label could we give to all the items in the same category?" (Recreation, gaming, industrial, utilities, housing, commercial.) If you have limited board space it would be okay to remove the lists of *possible uses* that were referenced to develop the categories of similar uses. Only the labeled categories will actually be needed for the remainder of the simulation Go to the next step.

4. Pose the question, "What is our vision of the Rancheria in twenty years? What sort of community do we want to live in? What opportunities should we be providing for ourselves and the future generations of the Rancheria? What are our concerns for the future?" Write all the suggestions on the board, and continue.

5. Categorize similar ideas and goals. Again, do not get bogged down in the details of grouping, but allow this to be an opportunity to relate the commonality of the student's objectives and perceptions. Also use this process to clarify and define the terms used. Students may express their views in very specific or abstract terms. Group ideas by their broad definitions and list more specific objectives under these headings. Continue to the next step.

6. Ask the students to consider the possible uses for the new addition to the rancheria generated in the beginning of the simulation. Ask "How can each one of these uses contribute to our vision for the future of the Rancheria? Do certain uses seem to complement or enhance others in promoting our vision for the future? Which ones (if any) seem to conflict with our vision for the future? How might these uses be altered or modified to resolve these conflicts?" Keep the group focused on one or two specific uses at a time. This may be a good opportunity to redefine priorities and concerns or identify new issues.



Developing and Giving Presentations

1. Divide the group into the number of land use categories identified, with not more than eight persons per group. Assign one of the categories to each group. One way to set up groups is to have the total group count off by the number of categories identified.

2. Inform the participants they have 10 minutes (or longer, time permitting) to list and analyze the advantages and disadvantages of possible uses for the new addition to the Rancheria in the assigned category. You may consider those listed on the board plus any other possible uses you can think of in your category. It is important to stress that this task is to just analyze the uses of the land.

3. (After the allotted time is up.) Tell the groups, "Your task is to develop a land use plan for the area in your assigned land use category." (About 20 minutes.) After each group has started their planning (5-10 minutes) go to step 4. If all the directions are given at first, many groups may start drawing a map before considering different land uses.

4. a. "We have just received word that because of the current workload from reading BIA memos, the members of the Tribal Council have all resigned. Each group has one minute to elect one member to represent them on the Council.

   b. One of the facilitators takes the new Council members to another room and:

• Tells them they have 15 minutes until the group meeting starts.

• Have them concentrate on developing a list of criteria that they will use to evaluate each proposal.

• Tells the Council to elect a chairperson to preside during the group presentations.

• Have the group decides which staff person will be the time keeper.

c. After the Council leaves the room, make this announcement.

"You have about 15 minutes to finish your plan and develop a 3-minute presentation to be made to the Tribal Council. Your 3-minute presentation must include a visual display, such as a land use map, as part of your presentation, and more than one person in each group must participate in making the presentation." Pass out colored markers and large pieces of paper to each group.

5. When all groups are ready, have the Tribal Council enter the room and sit at the front. The timekeeper is to stop all presentations at 3-minutes and give 1-minute warnings.

6. When the presentations are finished, the Council retires for 10 minutes to select the best proposal.

7. "While the Council is meeting, each group is to develop a list of ways in which their plan could be redesigned to be more inclusive of other groups objectives without compromising the "bottom line" of their own proposals. What are they willing to concede to? What do they believe is essential to the success of their own plan?

8. The Council enters the room, reads their criteria for evaluating the groups aloud, announces their decision, and reads criteria used in making the decision. The group who's plan was choosen may share with the class how they might modify their plan enlight of what they have learned during the simulation.

Have the Council members return to the groups that selected them and continue on to the next section. The main purpose here is to evaluate the process, not to get bogged down in the content of the issues and various plans.

Discussion

1. "What additional information would you have liked to have for planning your group's proposal?"

Examples might be: Topography, cultural sites, vegetation, climate, soil survey, historical land use, transportation resources, flood plain, wildlife, funding sources, regulations, regional economies, political climate, educational resources, population information (age needs, race, education, primary concerns), social history of region, etc.

2. "Where would you go to collect information on these topics?"

3. Point out to the group that this is one of the most important parts of the activity because it emphasizes that we need a variety of information and data before we can intelligently make a land management decision to best meet the needs of the people and the environment. This list has many of the elements that need to be considered in studying a local environmental issue or concern. It also includes elements of all the curriculum subject areas (social studies, science, language, arts, etc.). Therefore, we have to use the total community as a classroom and learning environment to collect the information required.

4. Discuss how this decision making process might be improved?

LESSON 18

Household Hazardous Waste Characteristics

Major Concept

Many items used in everyday life can be dangerous to people if not handled properly.

Objectives

Upon completing this activity students will be able to describe the:

1. difference between corrosive, reactive, flammable, and toxic materials; and

2. proper storage of each.

Background

Waste from homes is considered hazardous if it is corrosive, reactive, inflammable, or toxic. CORROSIVE materials destroy metal surfaces and living tissues.They chemically change what they touch. Corrosive substances are acidic (pH less than or equal to 2), or caustic (pH greater than or equal to 12.5). REACTIVE materials are very unstable and interact violently with the substances around them, especially air or water. They are explosive, and can sometimes create toxic fumes. FLAMMABLE materials will burst into flames if they come into contact with sparks or flames at specific temperatures. The temperature at which this happens is referred to as the "flash point." TOXIC materials cause immediate or long term negative health problems. Exposure to toxic materials may result in injury, illness or death.

Grades:
Intermediate.

Subject:
Science.

Time:
Two class periods.

Materials:
Learning Station 1:
One plain (steel, non galvanized) nail, 50 ml of 10% solution copper sulfate, 125 ml beaker.

Learning Station 2:
One gram baking soda, 50 ml of vinegar, 250 ml beaker.

Learning Station 3 (teacher demonstration):
Match, burner, hot plate.

Procedure

Introduction to Hazardous Characteristics

1. Review which products used in the home are hazardous. List these products on the board.

2. Discuss that these products are hazardous because they have one or more of the following characteristics: corrosive, reactive, inflammable or toxic.

3. In small groups, have students categorize the hazardous products list by what they think is the dominant hazardous characteristic in the product. (Most hazardous products have more than one hazardous characteristic. Ask students what they think is the most common characteristic in hazardous products (toxic, flammable).

Hazardous Characteristics Learning Stations

In small groups, students will rotate through learning stations that demonstrate three characteristics of a hazardous substance (corrosive, reactive, flammable). For detailed instructions, see the lab sheet on the following page. Below is a brief demonstration description. Toxicity, the fourth characteristic, requires a long-term experiment. Please refer to Toxicity: A Relative Term.

LEARNING STATION 1: Corrosive. Students will observe the reaction of a plain nail (steel, non coated, non galvanized) in 10% solution of copper sulfate. The nail will become visibly corroded.

LEARNING STATION 2: Reactive. Students will add baking soda to vinegar and record their observations. This reaction of the baking soda and vinegar forms carbon dioxide.

LEARNING STATION 3: Flammable. The teacher, not students, will conduct this demonstration. This demonstration will show that heat, friction and exposure to flame causes an flammable material to ignite.

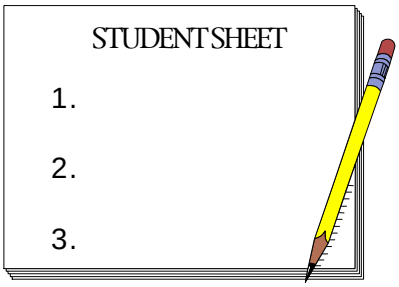
1. Strike a match in order to light it. (Note: You can also use a "Strike Anywhere Match," and see if students know why you are able to light it.)

2. Light a match by leaning it against a lit burner.

3. Light a match by placing it slightly above a heated hot plate.

After each of these demonstrations, have students list the steps that occurred in order to ignite the match.

After students have completed the stations, discuss the questions on the student sheet. Discuss why students think it is difficult to include an experiment on toxicity in a one-day lab. What are their ideas for designing an experiment to test toxicity?



Using and Storing Hazardous Products

Based on what they learned in the experiments, student groups should create guidelines for storing hazardous products. Discuss each groups' ideas with the class.

General Guidelines for Storing Hazardous Products

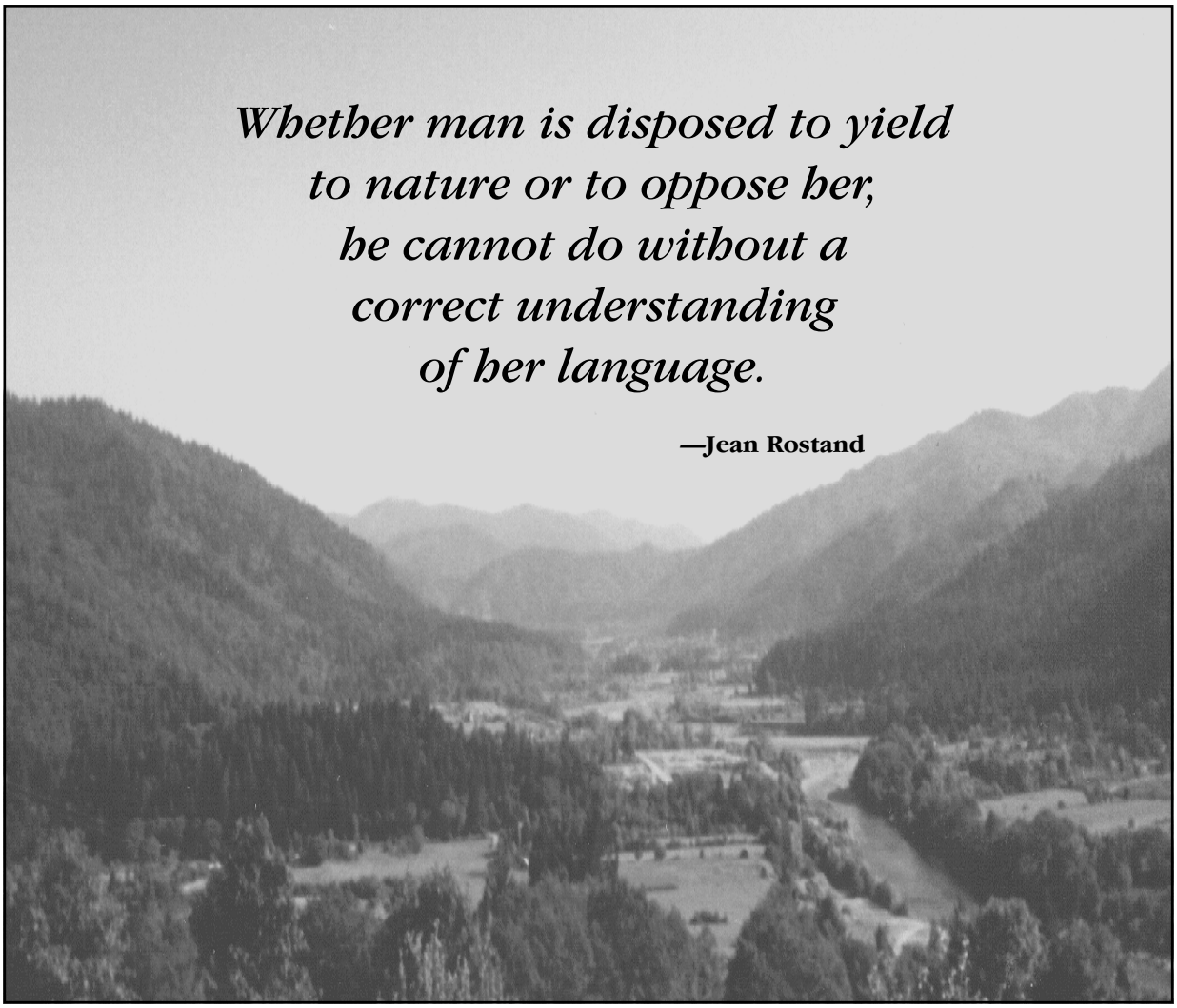
Flammable products: store away from heat and any source of ignition (sparks, friction); anything that can easily catch on fire should not be near flammable products.

Toxic products: store in locked cabinets; toxic products should be properly labeled and in their original containers.

Corrosive products: keep the product in its original container (if it is placed in another container, there is a risk that it may corrode the container); make sure the product does not come into contact with anything in which it may react.

Reactive products: store away from any substances that will cause a violent reaction.

Adapted from T*eaching Toxics*, Association of Vermont Recyclers, POB 1244, Montpelier, VT 05601, 1992.



Student Worksheet

The Characteristics of a Hazardous Substance

STATION 1

Directions:

1. Place the nail into a 10% solution of copper sulfate (10 ml cs/100 ml water).

2. Record your observations after 5 minutes and after 10 minutes.

   5 Minutes:

   10 Minutes:

Questions:

1. What happened to the portion of the nail that was submerged in the copper sulfate?

2. Why do you think this happened?

3. What are the results of corrosion?

4. Based on your observations, how would you define corrosion?

5. What examples of corrosion do you see in your life?

Student Worksheet

The Characteristics of a Reactive Substance

STATION 2

Directions:

1. In a 500 ml beaker, measure out 50 ml of vinegar.
2. Add 1 g of baking soda to the beaker.
3. Record your observations

This experiment demonstrates what reactive means. It demonstrates a safe reaction.

When we say something is hazardous because it is reactive, it means that a violent reaction can occur, or a toxic gas can be formed as a result of mixing with another substance.

Questions:

1. Based on the results of this experiment, how would you define reactive?

2. Would it be dangerous for a reactive waste to enter a river? Why or why not?

Teacher Demonstration

STATION 3

Write down the steps involved for each method your teacher uses to light the match.

For each method explain why you think the match caught on fire.

METHOD 1	METHOD 2	METHOD 3
Explanation		

Question:

Based on your observations, how would you define flammable?

LESSON 19

Hazardous Wastes in My Home?

Major Concept

Toxic, flammable, corrosive and reactive substances are common items in today's households.

Objective

As a result of this lesson students will be able to demonstrate an understanding of the basic characteristics that identify use and store household hazardous waste

Background

Household hazardous wastes have been characterized and labeled in a variety of ways. If a chemical is considered a hazardous substance, by definition of federal labeling laws, the product is subject to labeling requirements. But there are many inconsistencies in the labeling of household products. Reading labels is a good habit to form, despite these labeling inconsistencies.

Grades:
Intermediate - Secondary.

Subject:
Science, Health.

Time:
Two class periods.

Materials (for the teacher:
Bring into the classroom examples of hazardous household substances: polishes, cleaners, pesticides, etc. Be sure that the container is empty, and the lid is taped shut. Also, bring protective gloves.

Materials (for the students:
"Inventory of Potentially Hazardous Household Products" handout.

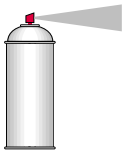
Procedure

Day One

1. Discuss: What qualities makes something hazardous? (Potential to be harmful to human or animal health; or the environment.) What is waste? (Something not needed anymore, or an unwanted by-product from the manufacture of an item.)

2. Show the overhead: "Household Waste." Inquire: What makes some substances more dangerous than others? (The amount required to cause harm.)

3. Divide the class into five groups. Give each group the chart on Household Wastes. Using the chart, tell the groups to prepare a report for class presentation. Let each group choose three products from the list generated in step 1.



Each report should cover:

a. the type of product (automotive, household, etc.) and what it is used for;

b. the characteristics that make the product hazardous;

c. the best way to dispose of the product (recycle, use up, etc.); and

d. a safer substitute.

Have each group give their report.

5. Distribute the hazardous household waste survey. Tell students they will use this form to find out what hazardous products they might have in their homes and how these products are labeled to warn the consumer. Stress that these products are potentially hazardous and that caution should be taken while doing this inventory. Tell the students to ask their parents for assistance.

6. IMPORTANT: Discuss and make sure students understand the provisions at the warnings on the first page of the "Inventory of Potentially Hazardous Household Products." Using the example products that are brought to class, show how to fill out the inventory.

Day Two

1. Discuss some or all of the following questions after the students have completed and turned in their surveys. A tally sheet for the class can be prepared that combines the results.

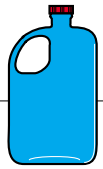
   a) Which items were found most frequently?

   b) Where were most of the products found? What are the best places to store potentially hazardous products? Did you find any products being stored unsafely?

   c) What was the most common warning on the labels? Did similar products have similar warnings?

   d) Which products had directions for safe disposal? Did any of the products mention the health effects that the product could have?

   e) Were any products found that did not have adequate warnings, or that were unlabeled?



Discussion

1. Name two potentially hazardous products that could be found in each of the following areas of your home.

   - bathroom (certain house hold cleansers, soaps)

   - kitchen (furniture polish, oven cleaner) garage.

2. Name four characteristics that identify a material as hazardous. What are the hazards that these products have? Can a product have more than one hazard?

3. What are four "warning" words (caution, dangerous, harmful,poison.) for hazardous substances?

CHART

Household Hazardous Waste

Auto battery	Corrosive, toxic	Recycle
Drain cleaner	Corrosive, toxic	Give to someone to use up or flush small amounts down drain
Empty aerosol can	Flammable, toxic	Place in trash for landfill
House cleaners with ammonia	Corrosive, toxic irritant	Give to someone to use up or flush down drain
Oven cleaner	Corrosive, toxic	Give to someone to use up or Hazardous Waste Collection
Rat poison	Toxic	Hazardous Waste Collection
Roach and ant killer	Toxic	Hazardous Waste Collection
Transmission fluid	Flammable, toxic	Recycle
Used motor oil	Flammable, toxic	Recycle

Inventory of Potentially Hazardous Household Products and Prohibited Waste Materials

NAME_____ **DATE** _____

This activity is an inventory. You are going to hunt around your house, basement, and garage to find out which of these products you have. Ask your parents to assist you with this activity.

CAUTION: Do not disturb or spill these products. Some of them might be harmful. Wash your hands carefully after you handle any container that might be leaking.

1. Check off items you find. Add others that are not on the list.
2. Write down the quantities you find. Write down how many containers and the size of the containers (12 ounce, 1 pint, etc.).
3. Write down where you find the product (under the sink in the kitchen, etc.). List both the room and exact location.
4. Read the labels of the products. Write down any warnings that are on the labels.

DO YOU HAVE....	HOW MUCH?	WHERE IS IT STORED?	WARNINGS	HAZARD CHARACTERISTICS
HOUSE				
Oven Cleaner				
Drain Cleaner				
Toilet Cleaner				
Rug cleaner				
Floor polish				
Silver polish				
Pool chemicals				
Mothballs				
Abrasive cleaners				
Ammonia				
Spot removers				

DO YOU HAVE....	HOW MUCH?	WHERE IS IT STORED?	WARNINGS	HAZARD CHARACTERISTICS
PAINTS				
Enamel				
Latex				
Rust paint				
Paint thinners				
Furniture strippers				
Stain or varnish				
AUTOMOBILE				
Antifreeze				
Brake fluid				
Transmission fluid				
Batteries				
Gasoline				
White gas				
Kerosene				

DO YOU HAVE....	HOW MUCH?	WHERE IS IT STORED?	WARNINGS	HAZARD CHARACTERISTICS
PESTICIDES				
Biocides				
Mouse poison				
Flea collars				
Insecticides				
Shower cleaners				
Slug baits				
Pesticides				
OTHER				
Fingernail polish				
Hair spray				
Magic markers				
Ammunition				
Plant food				

LESSON 21

Where Should It Go?

Major Concept

Household hazardous wastes must be placed somewhere that is safe for the environment.

Objectives

As a result of this activity students will:

1. demonstrate an understanding of the environmental consequences, particularly the effects on surface water, and the water table, from unsafe household hazardous waste disposal habits or practices.

2. be able to identify where persistent household hazardous wastes go when they are thrown out; and

3. be able to state the proper disposal method of different household hazardous wastes.

Grades:
Intermediate - Secondary.

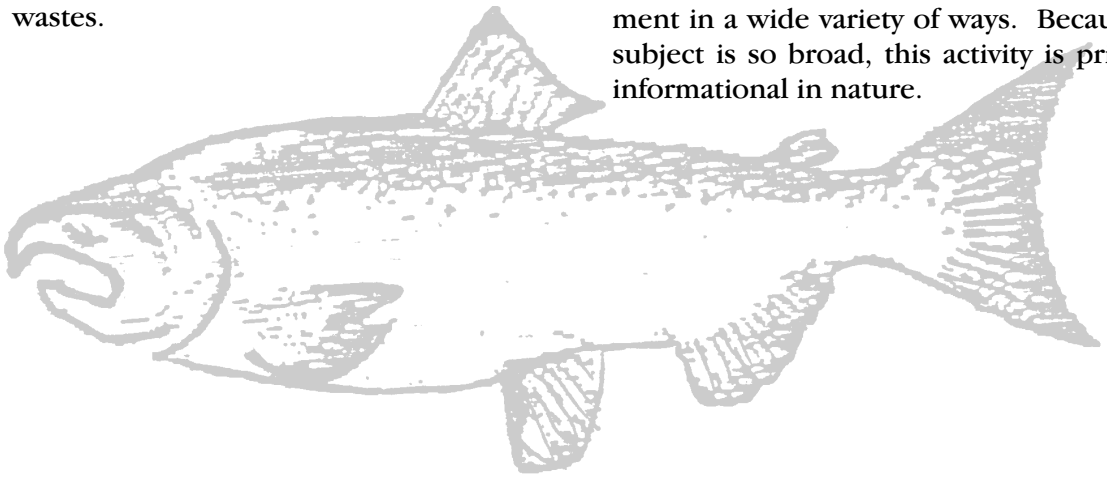
Subject:
Science, Social Studies.

Time:
Three class periods.

Materials:
Examples of commonly used household hazardous products, such as motor oil, pesticides, paint thinner. Protective gloves.

Background

Hazardous substances can enter our environment in a wide variety of ways. Because the subject is so broad, this activity is primarily informational in nature.



Procedure

1. Bring to class one or two examples of common household hazardous substances. Motor oil, herbicides, and paint thinners are good examples of products that are known to be persistent and long lasting in the environment. Handle these products with care. Restrict student handling of these products. Wearing gloves for protection will emphasize the hazardous nature of these products.

2. Explain that some combinations of hazardous chemicals degrade (break down) quickly into safe, naturally occurring substances. Explain that this activity is primarily concerned with persistent hazardous chemical combinations, i.e. those that remain unchanged in the environment for long periods, or with chemicals that combine with natural substances in such a way as to pose a hazard to humans and other living organisms.

3. Show the products that were brought to class. Ask: What should we do with these products when we are through with them? What are the different ways we might dispose of them? Tell students that some disposal options are not only bad for the environment but illegal in some places. However, for the purposes at this activity the students should think about what happens to substances when they are disposed of in various ways. Discuss with students any disposal directions that are written on the product; for example, most motor oil containers suggest recycling.

4. Discuss with students that the study of ecology involves the examination and understanding of connections. Tell students that the class will now consider how each of the possible ways people might dispose of household hazardous waste could be connected to food and water supplies.

5. Inform students they are now going to consider where wastes go. Point out to the class the various ways a chemical can travel through the environment from our homes.

6. Divide the students into groups or pairs and assign a different disposal method to each group.

   Incineration
   Storm drain, ditch, hole in the ground
   Sink/toilet; garbage can
   Household hazardous waste collection

Have each group brainstorm several minutes about where substances disposed of by their disposal method might end up. A different hazardous product can be assigned to each group. Pass out the appropriate disposal option sheet to each group. Questions that each group can ask themselves are:

If we dispose of the product by this method what might happen?

Is there any way that wildlife might be harmed?

Is there any way this product could get into our drinking water?

Is there any way this product could get into our food?

7. Have the groups share their ideas with the rest of the class. After each group presents their ideas, discuss with the class the information contained in disposal option sheets that are included with this activity. A different disposal option can be done each day, if preferred. Ask the class to vote on the best disposal choice for each product.

8. After all the options have been discussed, review with the class where persistent household hazardous waste goes. Ask: What can we do to reduce the amount of household hazardous waste we produce, in other words, eliminate or reduce the waste before it becomes a problem for us and the environment? Have students brainstorm ways to prevent persistent hazardous substances from harming the environment. Have them think of solutions they themselves might do, such as:

   - Buy and use what you need.
   - Learn to read product labels.
   - Use safe substitutes.
   - Use up what you do have or find someone who can use it.
   - Take it to a hazardous household waste collection program or recycling center, if appropriate.

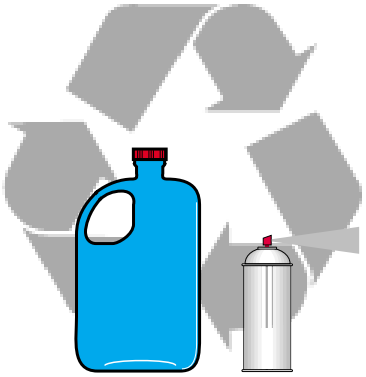
DISCUSSION QUESTIONS

1. Why are persistent hazardous substances of particular concern in waste management?

2. What is bioaccumulation?

3. Name four different household hazardous wastes disposal options and an example of a product that should be disposed of using each option.

4. How can we reduce the amount of household hazardous waste we produce?



Adapted from *A-WAY WITH WASTE,*
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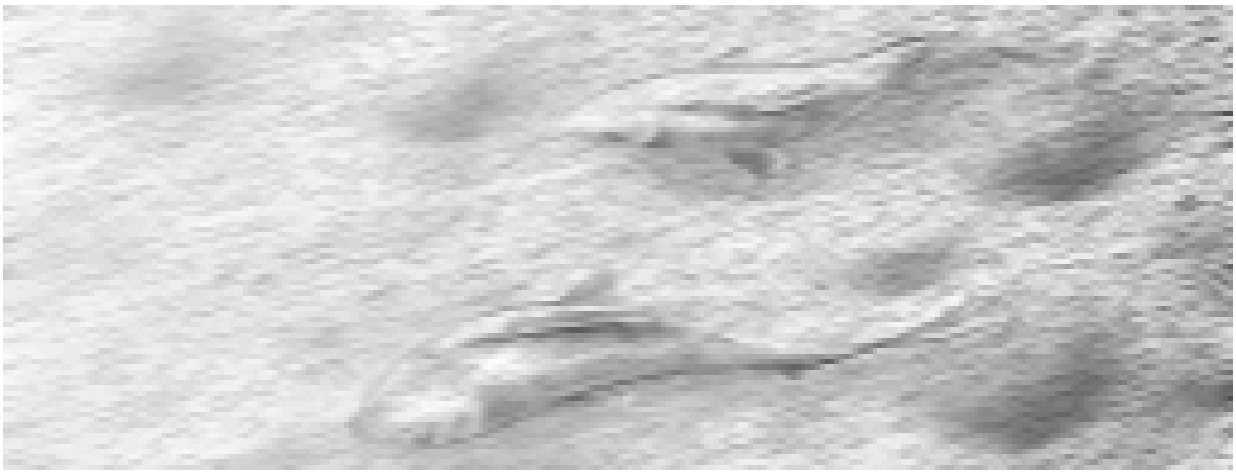


COMMON DISPOSAL METHOD INFORMATION SHEET

INCINERATION

If you burn your household hazardous substances, what happens? This depends on the type of chemical in the waste being burned. A pressurized aerosol can could explode and cause injury. Burning paints could leave a toxic residue of heavy metals. Burning rags soaked with cleaning fluid might simply vaporize the liquid into the air. This would disperse it and thus make its concentration very low. Burning plastic containers or certain solvents however could release potentially harmful fumes like hydrogen cyanide or chlorine-bearing compounds that are harmful if inhaled. Some of the chlorine-bearing compounds do not break down easily and last a long time. Over a period of time, these compounds can accumulate to levels that are harmful to the atmosphere.

The burning of hazardous household items by individuals is never complete. This means that small particles from paper or cloth are released into the air. These particles, which can carry hazardous substances, may settle and form a very thin layer called a micro layer on different surfaces, such as plant leaves. The hazardous substances in the layers can interfere with vital biological processes. Micro layers can also form on the surface of water. Because micro layers form at the place called an interface where two different states of matter meet, such as liquid and gas, or solid and liquid, it is much more likely that hazardous substances will become concentrated in these micro layers.

Finally, human beings can breathe small particles into their lungs and thus introduce the absorption of hazardous materials into the bloodstream. (Our lungs interface with the atmosphere.)

COMMON DISPOSAL METHOD INFORMATION SHEET

STORM DRAIN, DITCH, HOLE IN THE GROUND

If you pour hazardous household substances into a storm drain, a ditch, or hole in your yard there is a good chance the substance will end up in a nearby stream, river or lake. Here is where the waste is likely to go.

First, the storm drain. The square metal grates at the sides or curbs of streets are called storm drains or catch basins. When it begins to rain, the first drops soak into the ground, but once the soil is saturated or it is covered by cement, the rain runs into these storm drains. They drain anything soluble on your driveway, yard, or street into the storm sewer system.

Once there, this runoff water enters pipes which carry into larger pipes or "trunk lines" buried under the ground. These pipes empty the water into the nearest waterway; a creek, river or lake. So if you pour used motor oil down the storm drain in the street in front of your house, it very well may end up on the feathers of ducks or the gills of fish in the Klamath river.

In Hoopa, the storm drains join sanitary sewer pipes and the runoff water goes to a sewage treatment plant. This is called a combined sewer system. In this case, the water containing your hazardous waste will be treated. Hoopa's sewage plant has only a single treatment stage which will not eliminate most hazardous substances. Other sewage plants have secondary treatment systems that eliminate many more hazardous substances. However, these are very expensive.

Next, the ditch, or your backyard. Most tribal lands have no storm drains. Once the soil is saturated, rainwater runs overland to the nearest ditch or gully and downhill to the nearest waterway. If you disposed of a household pesticide in your yard and it rained hard the next day, the rain would carry your waste overland along the ditches to a waterway or down into the ground water.

"Ground water," "water table," "aquifer," "artesian well," "springs" all are names which describe where water is and what water does underground. Water drains or soaks into the ground until it hits an impermeable (difficult to penetrate) layer. The water then collects in the spaces between sand, gravel or rock particles. Underground areas where ground water collects are called aquifers. Some aquifers replenish lakes or streams. Others are enclosed by layers of rock and do not move. Wells are drilled into both kinds of aquifers, those that flow and those like pockets. Aquifers around the country are becoming contaminated at an alarming rate, threatening drinking water supplies.

Where does your drinking water come from?

COMMON DISPOSAL METHOD INFORMATION SHEET

SINK / TOILET

When you pour the substance down the sink or flush it down the toilet, where does it go? It goes either to the sewage system or into a septic system.

The sewage system is a network of underground pipes that collects liquid waste from each house, store, office, factory and building and brings it together into huge pipes called trunk lines. These trunk lines carry enormous volumes of waste. Not all that long ago sewage used to be dumped directly into rivers, lakes, bays and oceans. What problems did this create?

At the sewage treatment plant the water is treated with chlorine to kill any disease-causing organisms in the raw sewage. Much of the solid materials and some of the heavy metals are also removed by allowing them to settle out of solution. Common heavy metals are lead, zinc, mercury, and cadmium. Exposure to heavy metals, in any other than small concentrations, can be harmful to humans.

Some of the hazardous substances in the sewage biodegrade, while others, including some of the heavy metals, settle out in a residue called sludge. This sludge is usually disposed of in a landfill but if it meets certain quality standards it can sometimes be applied as a fertilizer to farm and/or forest land. The EPA has set standards for the level of hazardous substances in sludge that may be used on farm or garden soils producing food.

Some hazardous chemicals can be absorbed by plants. These plants, in turn, are eaten by animals and the chemicals can accumulate and concentrate to dangerous levels. This process is called bioaccumulation. As a substance moves from one organism to another through being eaten or absorbed, the substance is said to move through the food chain. Each link in the chain may accumulate the hazardous substance at higher concentrations. Human beings are often at the top of a food chain, which means the food we eat has had a chance to bioaccumulate many times.

If your house is not connected to a sewer system, it is probably attached to a septic tank. Gallons of water and sewage a day go through these septic systems.

Bacteria break down much of the waste entering a septic system. However, if you pour or flush hazardous waste into a septic system, the waste can kill these helpful bacteria and will contaminate the septic system's drain field soil or the septic tank sludge. The sludge, removed every four or five years from the septic tank is disposed of either at a sewage treatment plant in a septic lagoon or in a sludge landfill (basically a hole in the ground). The septic system cannot last indefinitely if the sludge tank is not pumped out periodically. At best, the bacterial action will stop allowing harmful substances into ground water and, at worst, the drain field will get blocked and cause the system to back up.

The suspected cancer causing chemical trichlorethylene, a powerful solvent and degreaser, has leached from septic tank drain fields in several places in the country to contaminate local wells. Chlorinated compounds make good cleaning agents, but they are persistent, toxic and mobile. Bacteria that can break down non-chlorinated substances cannot biodegrade these compounds, which pass through such systems into the drain field and ultimately may end up in drinking water sources.

COMMON DISPOSAL METHOD INFORMATION SHEET

GARBAGE CAN

Once you have put your trash in the garbage can, until recently, you probably didn't think about it anymore. But lately garbage has been much in the news. Have you ever heard of the garbage barge?

What happens to your garbage? Where does it go?

In some areas, your trash goes to a transfer station. At the transfer station, the garbage is sometimes separated and then taken to a landfill.

The waste at a landfill is heavily compacted. As a result, almost any container will break and its contents spill. Now the problem is leachate.

At the landfill, rainwater and any liquids in the waste soak through the garbage. Soluble (dissolvable in water) hazardous materials may be washed down with them. This liquid mixture is called leachate. Leachate will go down through the soil until it reaches an impermeable layer (a layer it cannot go through), or it will flow downhill over the surface. Leachate can contaminate ground and surface waters. Modern landfills are lined with a nearly impermeable layer of plastic. The purpose of the plastic liner is to retain the leachate, and channel it so it can be pumped out at a special collection point.

So, if you throw hazardous household items in the garbage can, the waste's persistent components may end up in the soil near your local landfill and it they get into the ground and surface water, who knows where they will end up.

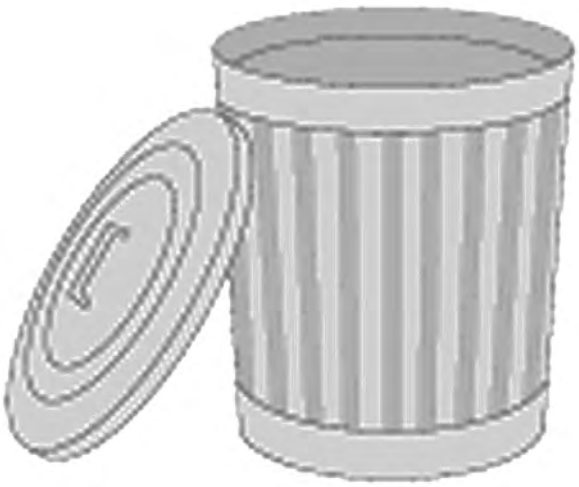
COMMON DISPOSAL METHOD INFORMATION SHEET

HOUSEHOLD HAZARDOUS WASTE COLLECTION

Several communities in California are now sponsoring household hazardous waste (HHW) collection programs. Tribal areas depend primarily on ground water for drinking, and people are concerned about safely collecting household hazardous wastes in order to keep them out of dumps and out of drinking water.

During a household hazardous collection program, people can bring in, generally at no cost, household hazardous materials. In cooperation with private hazardous waste management companies, local, county and state workers record and pack household hazardous waste in drums for shipment.

Some of the material can eventually be rendered safe by hazardous waste management companies using various chemical, physical and/or biological techniques. Some can be recycled. Some must be shipped at high cost, for disposal in a hazardous waste landfill or high temperature incinerator. If you participate in a HHW program and take you household hazardous waste to a collection site, your waste will be safely handled. It will be transported for treatment, recycling, reclamation, long term storage or disposal.



Where will it end up ?

Household Hazardous Waste
Disposal Choices

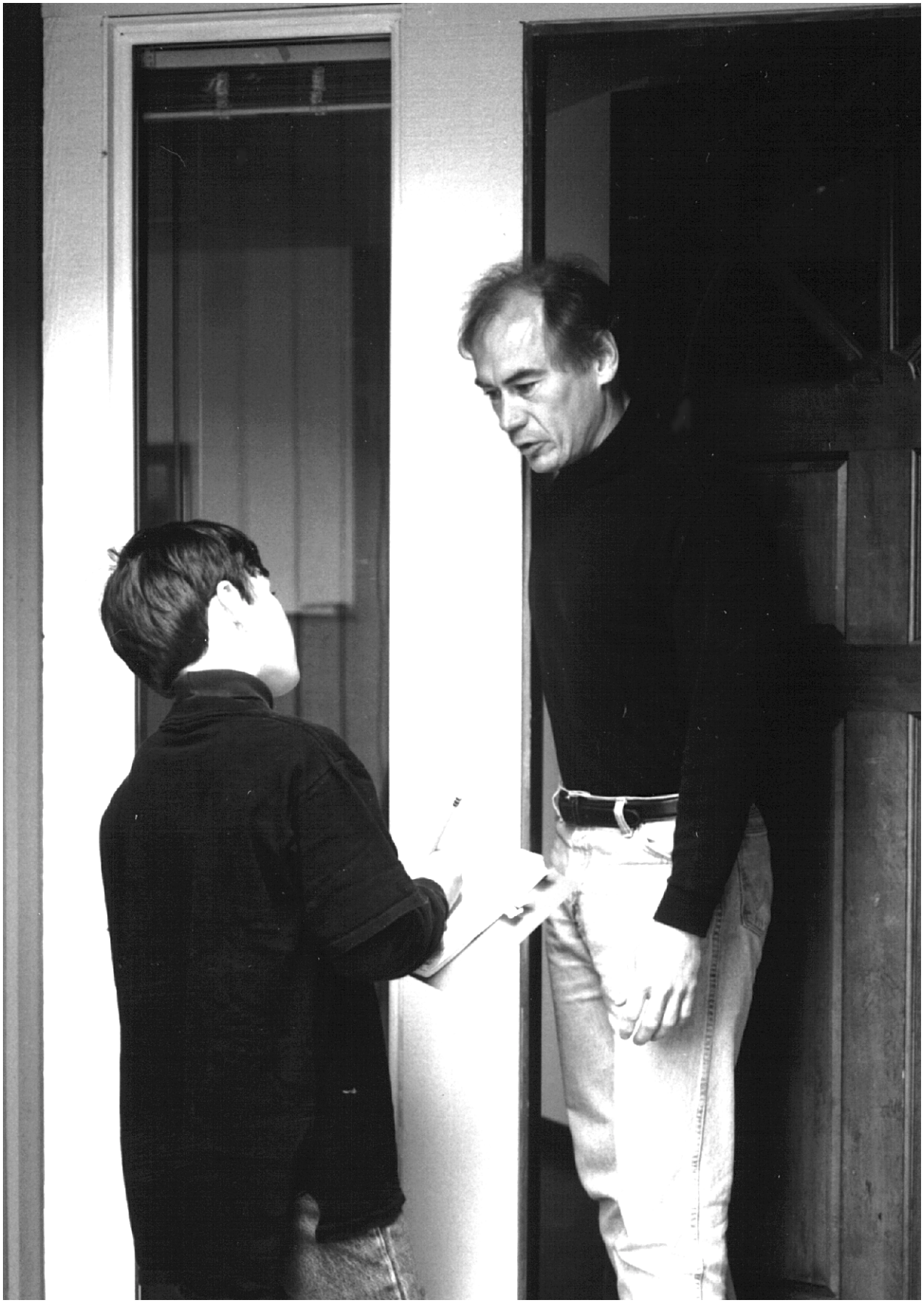
Incineration • Storm Drain/Ditch/Hole in Ground
Sink toilet • Garbage Can
Household Hazardous Waste Collection

Disposal Choice:

	Product	Air	Water	Land	Wildlife	Fish	Other
1.	Paint Thinner						
2.	Motor Oil						
3.	Weed Killer						
4.	Aerosol						
5.							
6.							
7.							
8.							

List four more products. Check disposal option that can lead to pollution in the water, air, land, etc.

Adapted from *A-WAY WITH WASTE* , 1990.



LESSON 21

Tribal Community Survey

Major Concept

Developing public awareness will result in better decisions about the environment.

Objective

As a result of this activity students will have:

1. a rudimentary awareness of how to design a survey instrument; and

2. an understanding of their community's awareness about household waste.

Background

An informed public is more likely to make responsible decisions about household hazardous waste disposal. The results from a residential survey of the city of Albuquerque indicated that 40% of those surveyed could name only one type of household hazardous product. The average household, however, contains a variety of hazardous products, ranging from shoe polish to flea collars. The survey also indicated that there is a wide range of opinions about what types of household products are considered hazardous. Twenty-five percent of those surveyed did not regard used motor oil as a hazardous waste. Other hazardous products not generally recognized as such include furniture polish, shoe polish, nail polish, and paint thinners.

Grades:
Intermediate - Secondary.

Subject:
Social Studies, Language Arts, Mathematics.

Time:
Three class periods, homework.

Materials:
Student survey sheet, and
the Albuquerque Survey Summary Sheet.

Procedure

Surveying the Situation

1. Pass out copies of a student survey. Have each student answer the questions. This survey will help students assess their own awareness of hazardous products.

2. Hand out the student sheet summarizing the Albuquerque survey results. In small groups, have students compare the Albuquerque study results to their own. Students should discuss why they think people are not aware of the hazardous products they use. Have the groups predict how their community will respond to a similar survey. Record these predictions.

Tell the class that they will test their predictions by conducting a survey to find out how much their community knows about household hazardous waste.

Designing a Survey

You will want to develop a Community Profile to help you understand the nature of your community. Do not worry if you cannot answer all of the questions right away—some will become clearer as you complete various activities.

1. What are the boundries of your community, and what is the population?

2. How many tons of garbage does your community generate each day? (The national average is about 4 pounds per day, or over 1,460 pounds per year per person, but each community is different.)

3. How much are tipping fees (costs to dispose of waste at the landfill) in your commuity?

4. What processes does your community use to manage solid waste? Is garbage burned for energy recovery, thrown in a dump, composted, or buried in a landfill? Is any of it recycled? (separate collection of newspapers, cans, bottles, or used motor oil, etc.). When will the local landfill be filled to capacity?

5. If there is a recycling program nearby, is it run by the tribe, county, or by private citizens? What products are made from the recycled materials? Also, are there any source reduction initiatives in your area, such as user fees for waste collection and handling, or education programs on source reduction?

6. As a class, discuss how to design a survey. Discuss:

   - What questions need to be asked to attain the survey's goals.
   - How you develop a procedure for survey taking.
   - The need to survey a representative sample of the community in order to avoid bias.
   - That students should define how they want to see the survey results.
   - That all survey questions must be developed to meet the goals.
   - What questions would be useful to ask to get these results?

7. Summarize the survey planning process (set the goal, define the procedure, define the results). Based on the class discussion, have student groups design a survey. Compile the small group work into one class survey.

Putting the Survey to Work

Work out the logistics for taking the survey. For example, if the class chooses to survey the school, one group may be responsible for questioning teachers, another group a certain grade, etc., in order to avoid replication.

For homework, ask students to survey a certain number of people. Students should make sure these people have not already taken the survey.

After the surveys are complete, compile the data. In small groups, have students organize the data in a meaningful way. Groups can then present major findings to the class.

As a class, discuss the following questions. What can you conclude from the results of the survey? What are the problems? How can you use this information to solve the problems?

Evaluate the survey process. What difficulties were encountered? Do students have any suggestions for doing things differently? Discuss the accuracy of this type of data collection. What biases may have been present?

Action Planning

In student groups, create a community education plan to address the needs indicated by the survey. Plans could include an information brochure, radio announcements, TV public service announcements, etc. Groups should create at least one example from their plan (i.e., design a brochure, tape a radio announcement, etc.).

Have groups create a theme slogan. The following questions will help guide a brainstorming session.

Who is your audience?

What do you want these people to do?

Create a list of words that describe your goals.

Put the word lists into phrases that combine positive descriptions with specific suggestions. Pointers for an effective slogan:

Make sure the message is not conflicting.

Don't force a rhyme; make sure your slogan makes sense.

Negative messages don't motivate people; they depress them.

Submit the survey results and the education plans to your tribal council.

Adapted from, *Teaching Toxics,* Association of Vermont Recyclers, POB 1244, Montpelier, VT 05601.

Household Hazardous Waste Survey
Survey Group: Student

1. **What do you think of when you hear the words "household hazardous waste?"**

2. **When is a product hazardous? During:**

   A. its use (1 pt.) **B. its disposal** (2 pts.) **C. its production** (3 pts.)

3. **Do you have hazardous products in your home? If so, name them.** (One point for each.)

4. **Circle the items that you think are hazardous products.** (One point for each.)

flashlight batteries	**motor oil**
shoe polish	**furniture polish**
nail polish remover	**oven cleaner**
antifreeze	**turpentine**
window cleaner	**gasoline**

5. **Does your home generate any household hazardous waste? If so, what?** (One point for each identified.)

6. **Do you know of any household hazardous waste that can be recycled? If so, what?** (One point for each identified)

Albuquerque Survey Summary Sheet

Albuquerque depends entirely upon ground water for its municipal water supply. After one of its wells became contaminated, the city needed to identify the source of contamination. In January 1983, city officials surveyed 386 households to see what waste generation habits could be contributing to water contamination.

The interviewers asked the households to identify as many types of household hazardous waste as possible. Twelve percent could not name any, and an additional 28% could only name one type. Thus 40% of those surveyed could not name more than one type of household hazardous waste. Interviewers also asked householders to rate how hazardous they thought certain items were. (See the chart below for results.) The next step in the survey was to try to determine how much household hazardous waste each household generated and how the householders disposed of such waste.

Product	Not Hazardous	Slightly Hazardous	Somewhat Hazardous	Very Hazardous	Extremely Hazardous
Pesticides	3%	4%	12%	21%	60%
Cleaners	12%	20%	31%	22%	16%
Polishes	25%	30%	27%	10%	9%
Drain Openers	2%	4%	10%	16%	68%
Motor Oil	25%	20%	33%	12%	10%
Antifreeze	11%	10%	24%	30%	25%
Paint Thinners	5%	11%	14%	23%	46%

LESSON 22

Stonefly - Steelhead - People

Major Concept

The environment is linked. A change in one part will cause a change in others.

Objectives

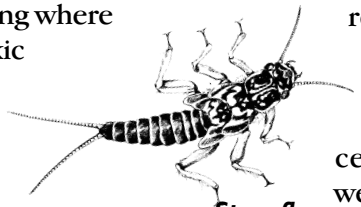
As a result of this activity students will be able to:

1. give examples of ways in which herbicides enter food chains; and

2. describe possible consequences of herbicides entering food chains.

Background

People have developed pesticides to control organisms. Herbicides are used to control unwanted plants; insecticides to control unwanted insects, etc. These pesticides are poisons, that frequently end up going where they are not wanted. Many toxic chemicals have a way of persisting in the environment, and often get concentrated in unexpected and undesirable places—from food and water supplies to wildlife and people.



Stonefly

For example, a pesticide called DDT used to be applied regularly to crops as a means of controlling insects that were affecting plants or trees. Then it was discovered that DDT entered the food chain with damaging results. For example, fish ate insects that were sprayed by the chemical; humans, eagles, and pelicans ate the fish. The poisons became concentrated in the birds—sometimes weakening and killing them directly, and over time resulting in side effects like egg shells so thin that the eggs would not hatch, or were crushed by the parents in the nesting process. The impact on species, including the bald eagle and the brown pelican, has been well documented. Use of DDT

Grades:
Intermediate - Secondary.

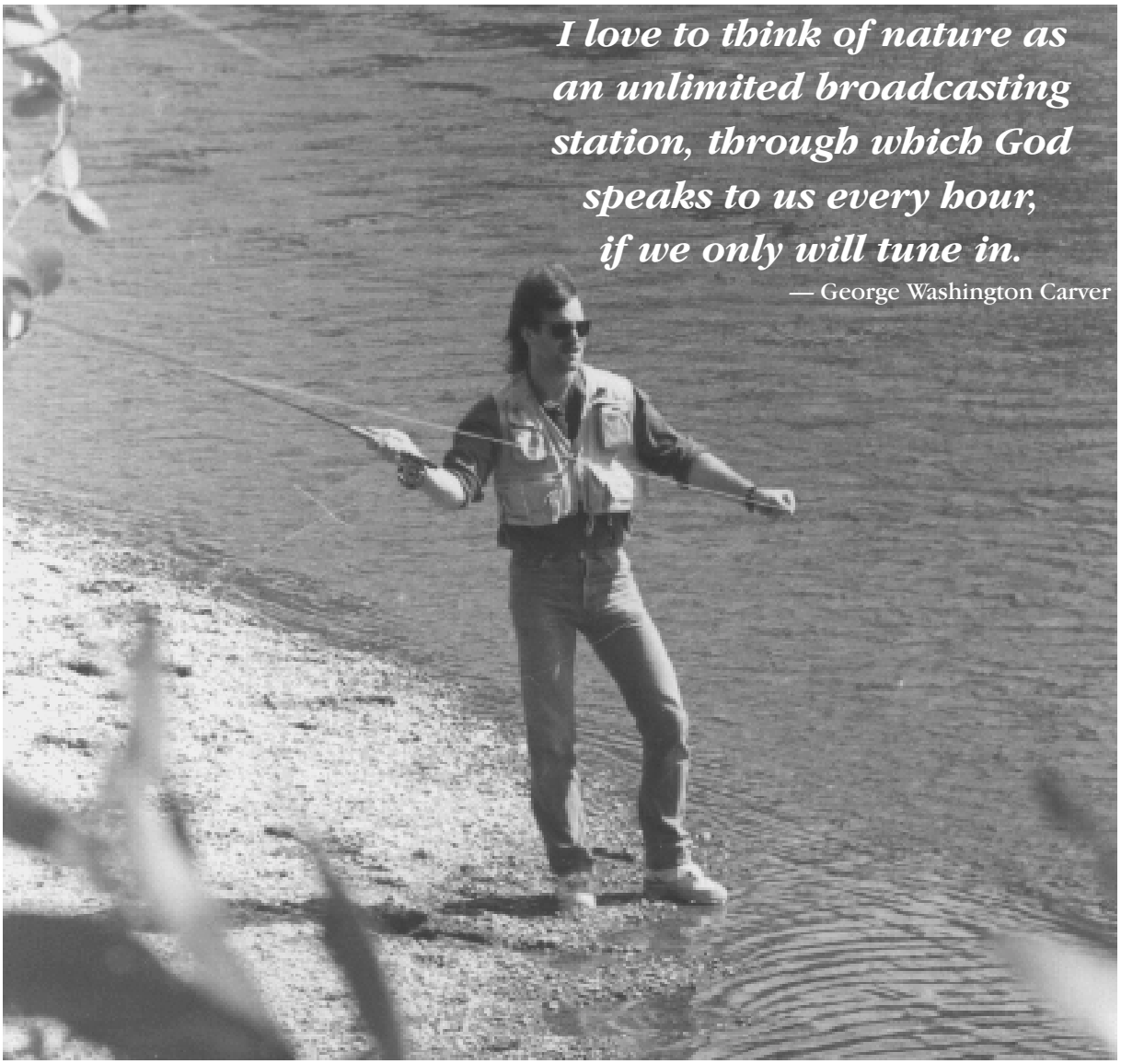
Subject:
Social Studies, Science, Physical Education.

Time:
One class period.

Materials:
White and colored pipe cleaners, one inch paper squares, six inch lengths of yarn, or any other material that can be picked up by students easily; 30 pieces per each student is recommended in a proportion of the two-thirds white to one-third colored pieces; one paper bag per stonefly (approximately 18-20).

has now been prohibited by law in the United States; however, it is still used in other countries, like Mexico.

Damaging fertilizers as well as pesticides are used by many farmers as a part of the agricultural industry. Again, use of such chemicals—particularly the inorganic, synthesized compounds—has varying side effects. For example, a pesticide (either insecticide, to kill insects, or herbicide, to kill unwanted plants) may be sprayed or dusted on a crop. The pesticide may settle into the soil, or stay on the crop, until it is washed by rain or irrigation into other water sources like ground water, lakes, streams, rivers, and oceans. Testing the water after this has occurred typically does not show a particularly high concentration of these human-made chemicals—but testing the fish often does. Waterfowl and other species may also be affected, including human beings, if people eat contaminated fish or waterfowl. Wildlife and people become the concentrators of the pesticide because the chemicals do not pass out of their bodies but bio-accumulate over time.



Procedure

1. Tell the students that this is an activity about "food chains." If they are not familiar with the term, spend time in establishing a definition.

Chain: a sequence or "chain" of living things in a community, based on one member of the community eating the member below it, and so forth; (e.g., stonefly eats plants like algae, steelhead eat stoneflys, humans eat steelhead).

2. Divide the students into three groups. In a class of 30 students, there would be two "humans," six "steelhead," and 22 "stoneflys." (Work with approximately three times as many steelhead as humans, and three times as many stoneflys as steelhead.) Optional: Have stoneflys, humans, and steelhead labeled so they can easily be identified; (e.g. blue arm ties for stoneflys, red bandannas for humans, and brown arm ties for steelhead).

3. Hand each "stonefly" a small paper bag, or other small container. The paper bag is to represent the "stomach" of the animal holding it.

4. With the students' eyes closed, or otherwise not watching where you place the "food," distribute the white and colored paper dots (or whatever material you use) around in a large open space. Outside on a playing field if it is not windy, or on a gymnasium floor; a classroom will also work if chairs and tables or desks can be moved back.

5. Give the students their instructions. The stoneflys are the first to go looking for food. The humans and steelhead are to sit quietly on the sidelines watching the stoneflys; after all, the humans and steelhead are predators, and are watching their prey. At a given signal, the stoneflys are allowed to enter the area to collect food and place the food in their stomachs (the bags). The stoneflys have to move quickly to gather food. At the end of 30 seconds, the stoneflys are to stop collecting food.

6. The steelhead are now allowed to hunt the stoneflys. The humans are still on the sidelines quietly watching the activity. The amount of time available to the steelhead to hunt stoneflys should take into account the size area. In a classroom, 15 seconds may be enough time; on a large playing field, 60 seconds may be better. Each steelhead should have time to catch one or more stoneflys. Any stonefly caught by a steelhead that is, tagged or touched by the steelhead, must give its bag of food to the steelhead and then sit on the sidelines.

7. The next time period (from 15 to 60 seconds, or whatever time you set) is time for the humans to hunt for food. The same rules follow. Any steelhead still alive may hunt for stoneflys; stoneflys are hunting for the food chips that represent algae or other plants; and the humans are hunting for the steelhead. If a human catches a steelhead, the human gets the food bag and the steelhead goes to the sidelines. At the end of the designated time period, ask all the students to come together in a circle, bringing whatever food bags they have with them.

8. Ask the students who are "dead," having been consumed, to identify what animal they are and what animal ate them. (If they are wearing labels, this will be obvious.) Next ask the humans to empty their food bags out onto the floor or on a piece of paper where they can count the number of food pieces they have. They should count the total number of white food pieces and the total number of multi-col-

ored food pieces they have in their food sacks. List any stoneflys and the total number of white and multicolored food pieces each has; list the number of steelhead left and the number of white and multicolored pieces each has; and finally, list the two humans and the number of white and multicolored food pieces each has.

9. Inform the students that there is something called a "herbicide" in the environment. This herbicide was sprayed onto the forest next to where the stoneflys were eating. This particular herbicide is poisonous to animals, accumulates in food chains, and stays in the environment for a longtime, In this activity, all of the multicolored food pieces represent the herbicide. All of the stoneflys that were not eaten by steelhead may now be considered dead, if they have any multi-colored food pieces in their food supply. Any steelhead for which half or more of their food supply was multicolored pieces would also be considered dead. The one human with the highest number of multicolored food pieces will not die at this time; however, it has accumulated so much of the chemical in its body that it will become ill. The other humans are not visibly affected at this time.

10. Talk with the students about what they just experienced in the activity. Ask them for their observations about how the food chain seems to work, and how toxic substances can enter the food chain, with a variety of results. The students may be able to give examples beyond those of the stonefly-steelhead-human affected by the pesticide in this activity.

Mayfly Nymph

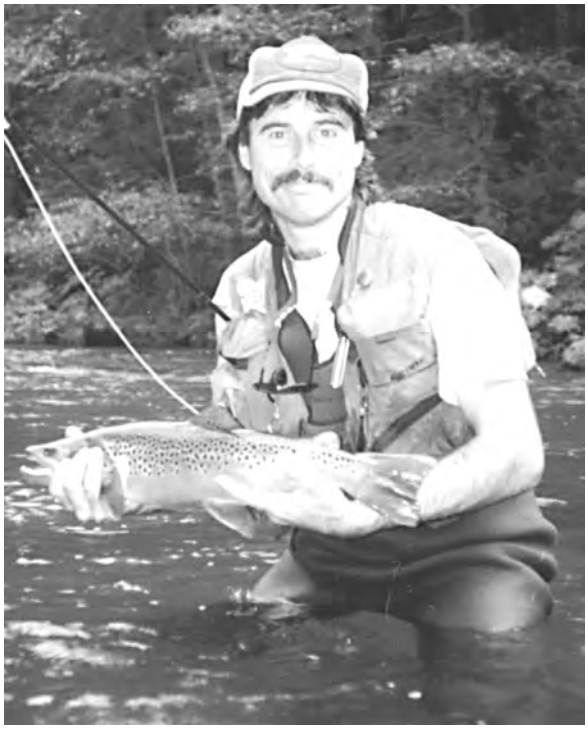
Adapted from *Project WILD,* Western Regional Environmental Education Council, 1993.

Extensions

1. Consider and discuss possible reasons for use of such chemicals. What are some of the tradeoffs? What are some of the consequences?

2. Offer and discuss possible alternatives to uses of such chemicals in instances where it seems the negative consequences outweigh the benefits. For example, some farmers are successfully using organic techniques (e.g., sprays of organic, non-toxic substances; crop rotation; companion planting); biological controls (e.g., predatory insects); and genetic approaches (e.g., releasing sterile made insects of the "pest species") in efforts to minimize damages to their crops.

3. Find out what research is going on to develop and test effects of pest control efforts—from effects of possibly toxic chemicals, to non-toxic alternatives. With what impacts? Tradeoffs? Potential?



LESSON 23

Salmon Creation Stories

Major Concept

Oral tradition provides the basis of culture. Salmon creation stories relate the close relationships Native American people on the northcoast have with the natural world.

Objectives

As a result of this activity students will be able to:

1. recall the details of one of the stories by drawing a picture of the events and/or retelling the story; and

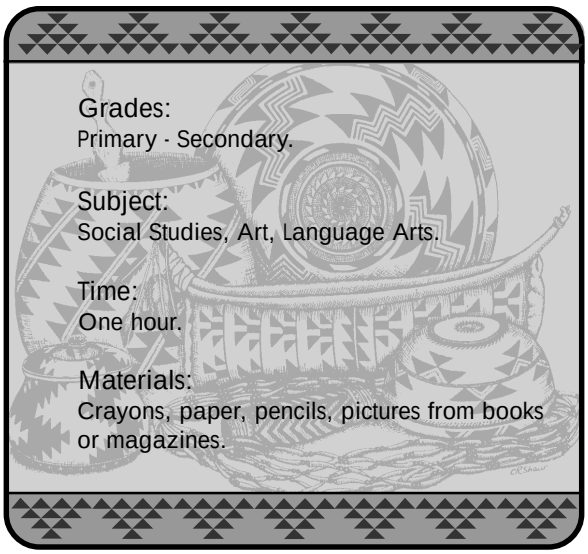
2. write the events of one or more of the stories and compare all three stories for similarities.

Background

Salmon and steelhead are important to the Yurok, Hupa, and Karuk people. Tribes lived near streams, or congregated near them during salmon runs. The fish were harvested with weirs, nets, or spears. The meat is preserved by smoking or drying.

This stored food helped the people to survive the winter. The salmon was considered a spirit, or a gift from the spiritual world, and was held as sacred. Many tribes would perform a "first salmon" ceremony before beginning their harvest. This involved recounting the oral traditions concerning the origins and travels of the first salmon. The salmon was thus ritually honored and induced to allow himself to be caught. If the first salmon was properly treated, he would act as the "leader" of the run to follow and supply an abundant catch. Although the Indians relied heavily on these fish as a food source, they never completely blocked or harvested runs, so the great abundance continued. Although the main character and some of the details differ, the essence of the stories is the same. A mythical figure or deity visits the realm of the spirits and releases salmon for people to use.

Yimantuwinyai ("The One Who is from Across the Ocean"), is a chief deity of the Hupa



people. "From the earth behind the inner house wall he sprang into existence. He established the order and condition of the world, and was responsible for releasing the earth's bounty for people to use. "There was no food for the people and he went to seek it. He found beings who had deer, the salmon and the eel held in an impoundment for their own use. Those he let loose by craft. He visited these selfish people and as a guest discovered the hiding place of the deer or salmon and, after throwing the keepers off their guard, tore away the walls."

Similarly, Wohpekumew is attributed with providing for the Yurok people.

"In the beginning there was nobody in the world. There were only spirits. Wohpekumew, the Great Spirit, called all the spirits together. They decided it was time to populate the world with people and give them trees, rocks, food and water."

Coyote was a mythical figure for many Indian tribes, and was often a trickster. In this legend he does a great deed for the people of the Karuk tribe.

Procedure

Listen to or read an Indian story about how salmon came to be, then retell and draw the story. Compare the three stories for similarities.

Begin by explaining that Indians lived entirely from the land. Their homes, clothes, food, tools, toys etc. were all elements of nature. They do not consider themselves separate from the natural world, as those from European cultures often do, but rather, they understood that they were an integral part of that world. All cultures have explanations (usually scientific or religious) for the way things came to be. The Indians have stories to explain how certain animals were "freed," so that they could become a part of the cycle of life.

Explain to your students that Indians kept no written history. Their culture was passed along to each new generation through stories, traditions and ceremonies. Because the stories were transmitted orally, some of the details might change, but not the essence. The underlying message would remain the same. For younger students, choose one of the stories and read it aloud to the class. Before you begin, ask the students to try to visualize the characters and the events as you read. Have some pictures on display that will help the children form images. When you finish reading, ask the children to draw a picture, or series of pictures, that will tell about the events of the story. The children can then show their pictures to the class and retell the story in their own words.

Older students can compare the three stories for similarities and differences. Students could construct a chart which summarizes the elements of the three stories or write a brief essay. The stories could also be retold by the students, either verbally, or in the form of skits.

Questions

Who freed salmon? Who was hiding the salmon? Where were the salmon hidden? What tricks or secretive behavior did the protagonist employ to release the salmon? Describe how the main character freed the salmon. What happened in the end? What are some common elements of the three stories? Why do you think these stories are similar, even though they are from different tribes?

Source: Diane Higgins

Yurok Salmon Creation

It was at Knek that they first made salmon. Two women lived there. There were no salmon in the world when Wohpekumow came. He entered and saw them. One said to the other, "What shall we eat?" She said, "Go up on the terrace." She climbed up while Wohpekumew sat and watched her trying to conceal what she did. She had a box with water and salmon inside. She took one out. Then they split it, put it on sticks, and broiled it. Wohpekumow put his hand into his carrying case and said, "I shall eat my salmon." They looked and saw him draw it out. It was really alder bark. They thought, "Where did he get his salmon?" for they were the only ones that owned salmon and had concealed them. Wohpekumew watched, thinking, "Let me learn with surety whether it is they who keep salmon, for I have never seen it before.

NOW when they cooked their salmon they put angelica root into its mouth before they set it by the fire, so that they might not have bad luck. Then they said, "Let us go out."

As soon as Wohpekumow saw that he was alone in the house, he went hastily to where he had seen them take the salmon. He found the box, tipped it over, and ran out. The water flowed to the river. Wohpekumow ran upstream. The two women pursued him. They were about to catch him when he saw two tan oak trees. He jumped between them, saying, "Spread span, they are about to overtake me." When he was between, they closed around him. The two women went around outside, unable to reach him.

Version told by Stone of Weitpus, 1902. Published in *Yurok Myths*, A.L. Kroeber. University of California, 1976.

How Coyote Freed Salmon for People (Karuk)

Nobody had fish. There were no fish in the river. After a while Coyote knew that two girls at Amaikiaram had fish. He had been thinking about that, "How am I going to fix it?" He took some alder bark. He fixed it all nice so it looked like the backbone of a fish. He put deer marrow on his imitation fish.

When he had fixed it up nice, he went up to Amaikiaram. When he arrived there, he went to the house where the two Ixkareya girls were living. He talked with the girls. They were cooking acorns. They gave Coyote acorns to eat. When they gave him the acorns, he took his imitation fish from his quiver and said, 'I'm going to cook fish." The girls looked at each other and asked, "Where did he get fish? Nobody's got fish." They thought this as they looked at each other. When Coyote cooked it, it looked like grease was dripping from it. It was the deer marrow. He never offered them any to eat. He pretended to eat it all himself.

Late in the evening the girls ate acorns. They did not eat fish. They had no sweathouse, so they had to let Coyote sleep by the fire in their house. Coyote just lay there, making believe he was asleep. He kept snoring away, but heard them all the time, for he was only pretending to sleep. After a while, one girl said, "I think he is asleep now," for they heard him snoring away. The girls got up and went outside. Coyote lay there snoring away. Then Coyote went outside. He knew where the fish were. He had expected the girls would go out sometime during the night and he would have his chance to release the fish, which the girls had impounded in a pond in a cave in the mountainside. Coyote released the fish, and they swam down the creek to the river. Then Coyote ran away.

Everybody thought he did right in releasing fish for people. Usually everybody runs down Coyote, but this time he did right. The girls were excited when they came back. One said to the other, "I told you he was not sleeping."

Version told by Georgia Orcutt, 1940. Published in *Karok Myths*, A.L. Kroeber and E. W. Gifford. University of California Press, 1980.

A Hupa Legend About How Salmon Came To Be

When Yimantuwinyai came back to Tcoxoltcwedin it occurred to him that there should be salmon. Someone had them shut up in the world across the ocean toward the north. It was a woman who guarded them. When Yimantuwinyai came to the place where she lived, he went in and addressed her as his niece. She gave him fresh salmon for the evening meal.

The next day, having spent the night there, he told her he would like some eels. When she went to catch them he followed to spy upon her. Having found out what he wished to know, he ran back and went into the sweat-house. The woman brought back the eels and dressed them. When she had them ready she called to him to come in. He went in and ate the eels. After he had remained there two nights he was again hungry for salmon. When she went for them he followed to see what she would do. He saw there the fishing boards projecting out over the water and many nets leaning up near by. There were also nets for surf fish there. He came back to the house.

The next time he was hungry for surf fish. He watched her net them as she had done before. When she had brought them up she cooked them for him between two sticks. He had now found out what to do. He made a flute and then smoked himself in the sweat-house. When he was done with the sweating he talked to the flute, telling it to play when he had gone out. In the evening he went and looked about everywhere to see where he had best dig the outlet. He saw the digging at one place would be easy. He went back to the house and sharpened a stick. He told the flute to play and went out taking with him his quiver which he left on the roof. Then he went where the fish were. There in a lake were all kinds which live under water. Beginning at a certain rush he dug an outlet. When the ditch was finished he took out the rush also. Then the water carrying the fish with it ran out encircling the world. He came back by the house he picked up his quiver and followed along beside the stream to teach the people how to prepare the fish for food. The woman ran along after the salmon that used to be hers, crying: "Wut-te wut-te my salmon." It was salmon's grandmother (a yellow breasted chat) who used to own the salmon. When Yimantuwinyai came along he saw fish had already been eaten. He saw eels had been cut. "Not that way, this way you should cut them," he said, cutting them with a knife of white stone. At another place he saw they were cutting surf fish which had come ashore. "Not that way," he said, "This way you must dry them," and he scattered them whole on the grass. He came back to Tcoxoltcwedin. Salmon's grandmother came on to Hupa following her fish. She still comes in the fifth month.

Told at Hupa, June 1901 by Emma Lewis. Published in *Life and Culture of the Hupa* by P.E. Goddard. American Archaeology and Ethnology, Volume 1, Number 1, University of California Press, 1903-1904.

We Don't Talk to the Fish Anymore

We don't normally talk to the fish anymore, but
That does not mean we no longer pray
for their well being, and
That does not mean we no longer offer
prayers of thanks to the Creator
by dancing the sacred dances,
and
That does not mean we no longer offer
prayers in the smoke of the sacred pipe.
We ask the spirituals to help and intervene
in the salmon's continuance
and therefore our own continuance.
But let us ponder,
What do the salmon have to ask of us humans?
They say;
Please don't pollute the water we breath in
because it hurts us as we suffocate!

Please don't dirty my children's womb
so they may not be aborted
and never be!

Please let our babies grow to be strong
so they may return to our natal streams
where the Creator meant us to be.

Please allow the Creator's purpose to prevail,
the continuance of creation,
for both the fish and mankind.

It is because of our purpose of sustenance
that man may continue in his spiritual journey
and successfully return
to the presence of the Creator,
as does all good things on earth.

—by Pudoh Hene, a Yurok 1992

LESSON 24

Recycling Used Oil

Major Concept

Because oil is not water soluable, people must be careful not to dispose of it anywhere it could pollute water.

Objective

As a result of completing this activity students will be able to explain:

1. how oil that is dumped in the natural environment can pollute water used for drinking; and

2. why oil should be recycled.

Grades:
Intermediate - Secondary.

Subject:
Science.

Time:
One class period.

Materials:
A small container of cooking oil, red tempera poster paint (water based), one glass bowl, one eye dropper, one funnel, very fine aquarium gravel or sand, one quart or gallon jar, one measuring cup, water, and small screen.

Procedure

Fill the glass bowl with water. Place several drops of oil on the surface. Note how the oil behaves. Ask the following:

1. What would happen to fresh water surface organisms like insect larvae in this water? (Oil interferes with the life cycle of organisms which use the surface layer as a nursery ground.)

2. Can you get the oil out of the water? Mix the solution.

3. Could the oil and water be separated now?

4. Would you drink the water? Could fish thrive in this water? What would happen if the oil coated their gills? (They would suffocate.) If they absorbed or ingested the the oil? (They could develop skin or liver cancer.)

Most people in Indian Country rely on ground water for drinking. Ground water is not usually in underground streams and lakes. It's usually stored in pores between rocks and gravel. These layers of rock and gravel containing water are called aquifers.

> Put a small screen at the bottom of the funnel and pour in 1/2 cup of fine aquarium gravel or sand. Place the funnel over a jar. Measure out 1/2 cup of water and pour it into the gravel. Measure how much flows into the jar. Ask: Where is the rest of the water? (Held in the spaces between particles of gravel. This is how ground water is stored in aquifers.)

When someone dumps used oil on the ground it can seep into this ground water. You can taste as little as one part per million. (1 ppm =1 gallon of used oil in one million gallons of water or = 1 minute in the life of someone 12 year old.)

> Drop two or three drops of red water based paint onto the water soaked gravel in the funnel. (Do not use oil based paints, they bond to the epoxy coating on some aquarium gravels.) Pour 1/2 cup of water through it (rainfall). Note how much oil or paint flushes through and how much remains in the gravel. Pour additional cupfuls of water over the gravel. Note the volume of water needed to rinse the gravel clean. Ask: Would you want to drink this water?

How can we keep used oil out of surface and ground water? (recycle used oil.)

Discussion

When you change the motor oil in a car, truck, motorcycle, or boat, what should you do with it? What should you not do with it? Why?

Adapted from, *The No Waste Anthology,* California Department of Toxic Substances Control, 1991.