

# LESSON

# 41



## LandFill Gas

### Major Concept

Methane gas is a by-product of decomposition that takes place in sanitary landfills.

### Objectives

As a result of this activity students will:

- 1) demonstrate an understanding that energy can be recovered from waste;
- 2) be able to describe the energy-producing potential of some solid wastes; and
- 3) be able to diagram a system of generating methane from waste.

### Background

Once buried, organic wastes decompose by bacteria. Carbon dioxide, methane, ammonia, and hydrogen sulfide gases are all produced as microorganisms break waste down. Trapped beneath the landfill surface, these gases become potential health and safety threats if not properly vented. To avoid explosions or lateral migration of methane beneath the surface of the landfill, vents are installed to reduce pressure build-up of the gases.

Methane is the largest component of natural gas.

Grades: Intermediate – Secondary.

Subject: Science, Social Studies.

Time: One class period to set up, one class period for conclusion.

Materials: Three beakers, Vaseline, organic slurry, balloon, three rubber stoppers, one foot of glass tubing or a "u" tube, 5 feet of surgical tubing, the nozzle from a medicine dropper, one pinch clamp.



If the landfill volume is great enough (at least one million tons), the methane produced can be captured, purified by removing carbon dioxide and water, and sold to gas utility supplies. Capturing methane from landfills may not turn a profit, but it can help to defray the landfill's operating costs and reduce pollution. There are at least 30 methane recovery systems operating or under construction in the United States, and at least 1000 landfills large enough to handle a methane recovery system.

## Procedure

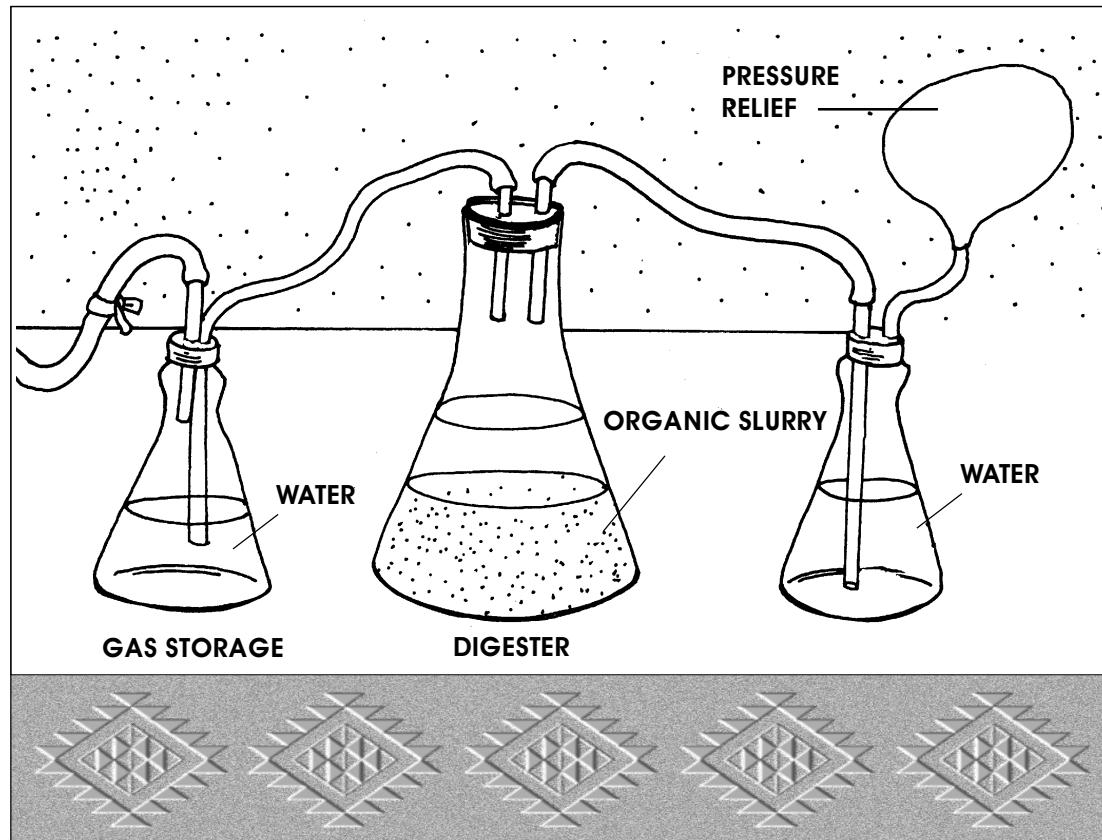
1. Fill digester about one half full with an organic slurry (i.e. manure and /or ground grass clippings, etc. mixed with water until a thick, but pourable, consistency is reached). Keep it warm. Wear safety goggles.
2. Bore two holes in a rubber stopper with a cork borer.
3. Run a tube to a gas storage container. (NOTE: Make sure all connections are tight. Use Vaseline on cork holes.) The container's lid should have two holes, one for the tube coming from the digester and one for a nozzle and clamp – this is your flare.
4. Run a tube to a pressure relief system. Use an easily expandable container or a balloon that has been blown up several times to stretch the rubber so it will be easier to fill from an empty state. Make sure tube from digester extends down into water. This arrangement will prevent an excess of gas from feeding back into the digester.

5. Build four or five, and have students test different organic wastes. Which produces the most gas the fastest? Which waste produces the best fuel?

## Questions

What is methane? How is it produced? List materials that can be used to generate methane. Describe another means of using solid waste to produce fuel.

Adapted from *AVR Teacher's Resource Guide*, Association of Vermont Recyclers, P.O. Box 1214, Montpelier, VT 05601



# LESSON

# 42



## Dr. Rock

### Major Concept

When developing land policies people need to consider many diverse opinions, and what will be best for all.

### Objectives

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

1. the impacts of forestry practices on health and culture;
2. why herbicides are applied to forest lands; and
3. the need for dialog between forest managers and the People.

Grades:  
Intermediate - Secondary.

Subject:  
Social Studies.

Time:  
Five class sessions.

Materials:  
Student hand-outs, and role-playing cards.

This simulation addresses the application of forest practices to a culturally sensitive area. Students will role-play members of the community, industrialists, and elected officials in a decision making hearing.

*Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it is the only thing that ever has...*

—Margaret Mead

### Background

A simulation is powerful tool for helping students understand the totality of a controversial issue. A simulation requires a student to play the role of a person with whom they would not normally associate. Acting out a public hearing allows students the opportunity to model the “real-world.”

### Procedure

1. Discuss the following questions:
  - a) What kind of things affect gathering and religious sites?
  - b) How do Indian people and non Indian people view religious sites?

- 
- c) What cultural activities do students' and their family participate in?
  - d) How does herbicides affect the environment?
  - e) What type of harmful affects do herbicides have on people?
  - f) How can Indian people and land managers control burning for bear grass?
2. Explain that the class will participate in a simulation of a community meeting sponsored by the United States Forest Service. The meeting will address a proposal by the Forest Service and Klamath River Logging company to log the Dr. Rock area and apply herbicides after replanting.
3. Distribute the "Student Handout Problem Sheet." Students will use this to prepare for discussion.
4. Distribute the role cards and split the class into twelve groups:
  - a) Tribal Council Member
  - b) Forester for Klamath River Logging Company
  - c) Manager of the Klamath River Logging Company
  - d) Tribal Member Living Near Dr. Rock
  - e) Native Log Truck Driver
  - f) Non-Indian Recreation Enthusiast
  - g) Gatherer
  - h) Indian Natural Resource Planner
  - i) Indian Medicine Doctor
  - j) Per capita Tribal Member
  - k) Non-Indian EarthFirst! Representative
  - l) National Forest Advisory Panel
5. Appoint a Forest Supervisor to preside over the meeting and head the National Forest Advisory Panel.
6. Participants read their cards, in groups discuss their options, and come up with their statements.
7. Convene the community meeting. The Forest Supervisor should restate the alternatives listed on the problem sheet.
8. Each group has three minutes for presenting their viewpoint.
9. After all statements have been heard, allow time for questions and rebuttals.
10. Have the Forest Advisory Panel recess for five minutes to make its consideration and recommendation.
11. Reconvene the meeting and have the Forest Supervisor announce the recommendation of the Panel.
12. Conclude with a class discussion on the outcome.
- 

## Summary

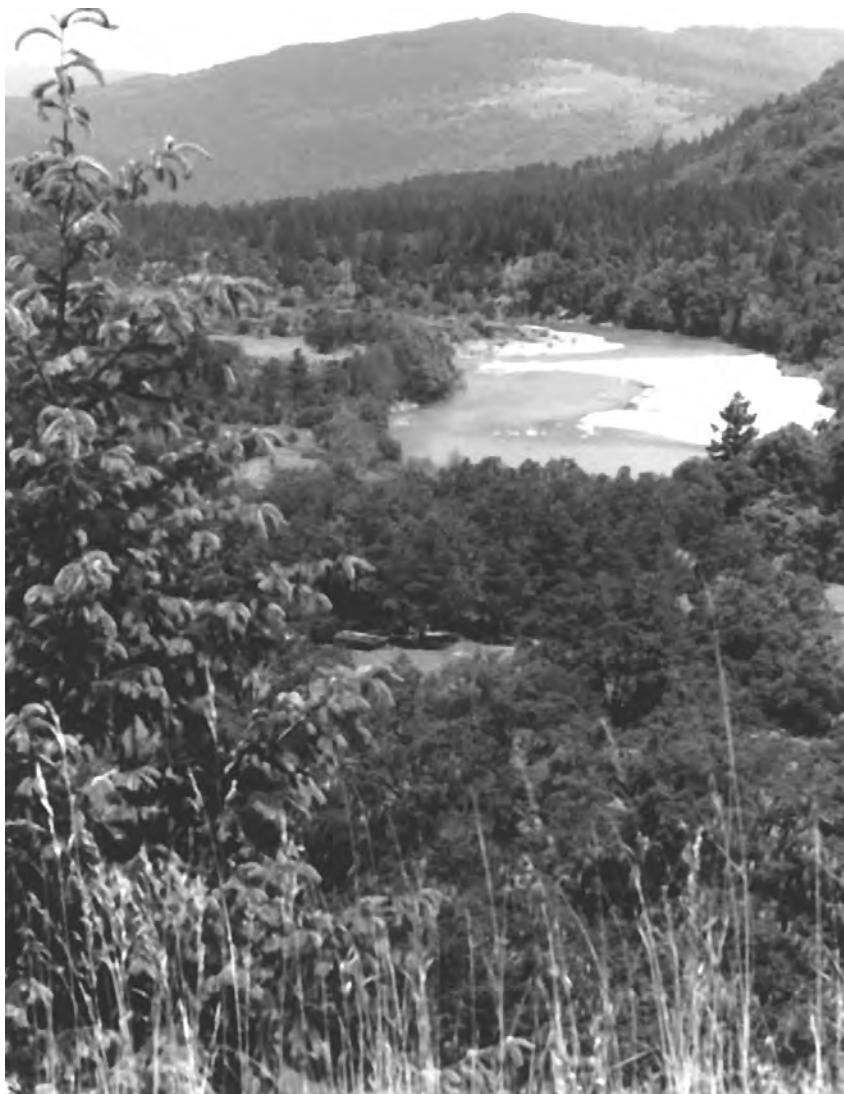
Discuss with students:

- 1. What difficulties did you encounter in preparing your position?
- 2. What factors did the Forestry Advisory Panel consider when making its decision? What

---

other factors do class members think the Panel should have considered? What factors should be considered in determining the welfare of the tribe as a whole?

- a. What effect did the special interest groups like the recreation and EarthFirst people have on the Panel?
- b. Are there any people whose needs were not represented? Were there



interests identified and considered in any way?

- c. Should the personal interests of the Panel members be considered in the decision? Why or why not?
- d. Were there any compromises to enable the Panel to make its decision? If so, what compromises? Did the compromises deal directly with the Logging and spraying proposal?
- e. Did anyone or any group look beyond their own special interests and consider the cultural needs of the tribe?
- f. Did anyone's point of view change as a result of the hearing? Why?
- g. What alliances were formed in an effort to persuade the Panel?





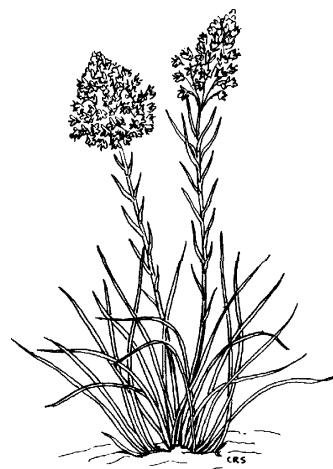
## Student Handout Problem Sheet

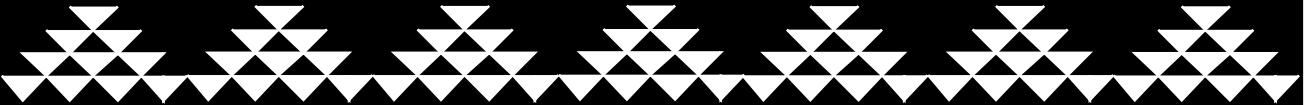
The United States Forest Service is considering logging adjacent to the Dr. Rock area. The proposal includes the possibility of clearcutting the forest and replanting with Douglas fir. Within five years of replanting, the area will be sprayed with herbicide to kill unwanted broadleaf plants that compete with the fir trees. The herbicide will be applied by helicopter.

The forest on the reservation next to the proposed logging site is similar. Therefore, a proposal to log tribal land in conjunction with the forest service site has been suggested by some members of the Tribal Council. The proposal states that logging tribal land will take place only if the logging off the reservation occurs. There has been no proposal to replant the forest or to apply herbicides on tribal land.

The terrain of the area proposed for logging, both off and on the reservation, is mountainous. The predominate tree species is redwood, yet there are substantial stands of spruce, oak, and madrone. Small patches (less than 3 acres each) of old growth redwood are present. The national forest was selectively cut eighty years ago. The reservation forest was selectively cut sixty years ago. Very few of the original roads used during the initial logging are in use today.

Medicinal and basket making plants grow abundantly throughout the area being considered. The area also has several salmon spawning and salmon rearing streams.





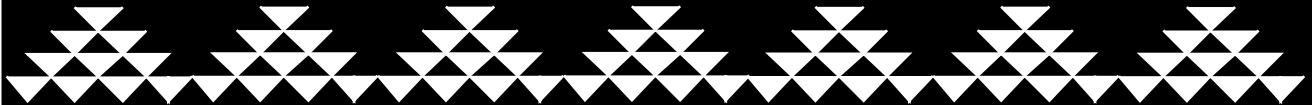
# Tribal Council Member

Unemployment on the reservation is the highest in ten years. Your main concern is for tribal members to have adequate employment. Logging the national forest will give some tribal members job opportunities. You are in favor of the Forest Service proposal to clearcut the national forest. If they do, it will place pressure on the tribe to log reservation land. This, you are also in favor of.

When planning your three-minute presentation consider the following:

1. Logging reservation land will provide additional jobs for unemployed tribal members and per capita payments to all.
2. The forest should be logged because it is old, not productive and a forest fire hazard.
3. The herbicide that will be used is safe. Government and industry sponsored tests have failed to prove it causes cancer or any other disease.





# Forester for Klamath River Logging Company

You are a registered professional forester. You have made an extensive examination of the National Forest Service land under consideration. Your position is based on science, not opinion. You are proud of that fact.

When planning your three minute presentation consider the following:

1. Your assessment of the forest is that it has gotten to the stage of no longer being productive.
2. The forest should be harvested in order for a new forest to grow.
3. The most effective way for a new forest to become established is to clear the land like nature would as a result of a fire.
4. Your recommendation is that the land be clearcut.
5. After the land is clearcut it should be replanted in Douglas Fir. This will assure a new crop of trees in the least amount of time, provided herbicides are used to kill broadleaf plants within the first five years.





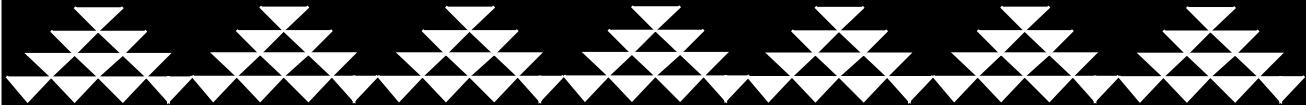
## Manager of the Klamath River Logging Company

Your company will most likely receive the contract to log the National Forest Service land. You need the contract to keep making money in a very competitive business. Your competitor, Trinity River Logging, has been getting most of the contracts lately and will put you out of business soon. Your argument before the Panel will be emotional, but you know an emotional approach will not work.

When planning your three minute presentation consider the following:

1. You need to convince the Panel that the Forester for Klamath River Logging Company has all the knowledge necessary to make the decision.
2. Klamath River Logging is a good member of the community. If your company does not do the logging it may go bankrupt. Going bankrupt will mean a loss of jobs for eight people in the community. It will also mean loss of income for many people in the area who provide services for the logging company (restaurants, gas companies, etc.).
3. If Klamath River Logging goes bankrupt the county will lose one million dollars per year in tax revenue.



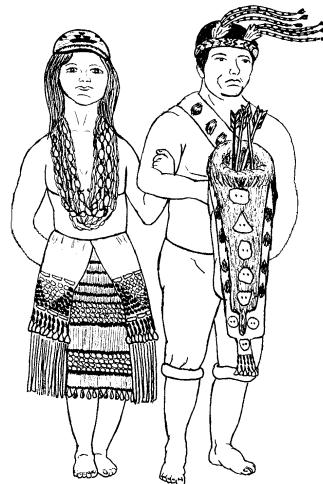


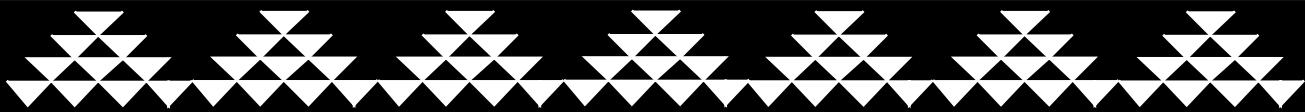
## Tribal Member Living Near Dr. Rock

You are a tribal elder. You are strongly opposed to any logging near the Dr. Rock area. You have been a gatherer all of your life. One of your aunts is an Indian doctor. The plants living near the area are important to basket making and healing. Logging outside the reservation might be acceptable only if you are assured logging will not take place on the reservation itself.

When planning your three minute presentation consider the following:

1. Clearcut logging would destroy the forest environment and kill the plants on which you depend.
2. Destruction of the plants used in baskets and healing will hurt your culture. Your people will lose a part of their identity. It is very important to you to carry on tradition.
3. You are especially concerned about the proposal to use herbicides. Several of your friends who live near areas in which logging companies have used herbicides have contacted strange illnesses, including cancer. You fear for your health, particularly because you place gathered materials in your mouth to keep them moist while making baskets.





## Native Log Truck Driver

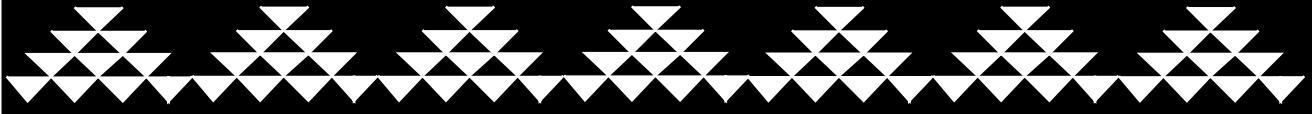


You are a thirty-five year old Gypo log truck driver. You have worked for the Klamath River Logging Company and for the Tribe hauling logs. You know that if the National Forest parcel is logged you will have plenty of employment. Also, if the tribal council decides to log reservation land you will have additional employment on top of your per capita payment. You have worked in the woods all of your life. You know no other way to make a living.

When planning your three minute presentation consider the following:

1. You have four young children, a wife, a pick-up truck monthly payment, and a \$500 per month payment on your logging truck. Your annual income is \$22,000.
2. If no logging takes place, you will go on unemployment.
3. If logging takes place on National Forest Service land but Klamath River Logging Company does not get the contract, you can still work for the company that does receive the contract. So, you don't care who does the logging, as long as it's done.
4. If the Forest Service land and reservation land is clearcut you will earn more than \$20,000 on this job alone.





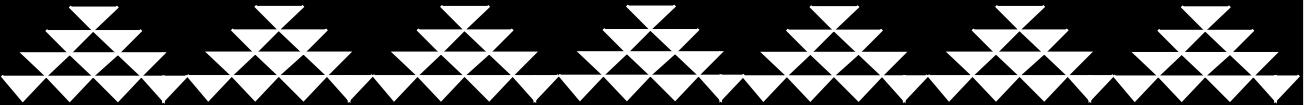
# Non-Indian Recreation Enthusiast

You are a student at the nearby university. You are majoring in recreation. Dr. Rock is a special place for you, because it is there you learned to rock climb. Even though Dr. Rock is accessible only by crossing private land after obtaining permission, you have visited it several times. You have never sought permission. You feel it is your right to have access to Dr. Rock for climbing. Logging the area would make it ugly. You don't think the logging company, Forest Service or the Tribe have the right to change the area.

When planning your three minute presentation consider the following:

1. The Dr. Rock area is a beautiful area that many people use for recreation. Logging the forest will destroy the beauty and people will have to go somewhere else.
2. Logging operations will be dangerous to people recreating in the area.
3. The next closest place to go rock climbing is thirty miles.





# Gatherer

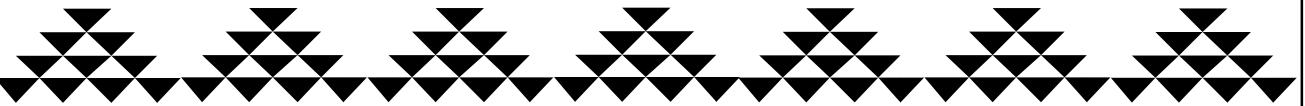
You have been gathering in the Dr. Rock area since childhood. It is one of the best sources for Beargrass. Clearcutting the forest will destroy the Beargrass and many other plant species on which you rely. Selective cutting might be acceptable if

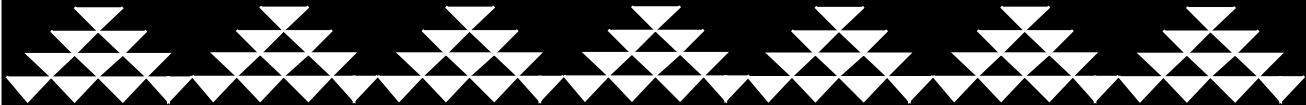
you are assured that it can be done properly. You need assurance from the Klamath River Logging Company Forester and the Indian Natural Resources Specialist that selective cutting will be okay. Otherwise, forget it. You do not approve of any logging on reservation land. Herbicide spray is frightening to you. You have had two family members die of cancer. You suspect that herbicide spray was the reason. Finally, you believe that Forest Service timber practices as they apply to adjacent reservation land is cultural genocide. You strongly dislike the Forest Service.



When planning your three minute presentation consider the following:

1. Any type of logging would destroy the forest environment and kill the plants on which you depend.
2. Destruction of the plants used in basket making will hurt your culture. Your people will lose a part of their identity. It is very important to you to carry on tradition.
3. The herbicide used in the past is very similar to Agent Orange, a herbicide used in Vietnam. Agent Orange has been associated with cancer and other ailments in humans. The government has denied a link between Agent Orange and disease, but independent researchers have said they are associated.





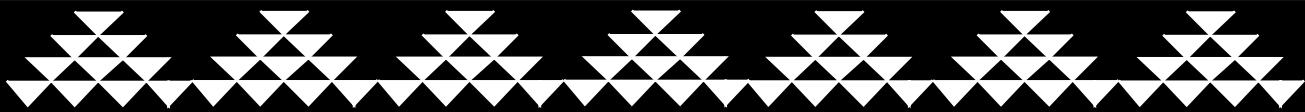
# Indian Natural Resource Planner

You work for the Tribe in the capacity of scientist. Your area of research is water quality and land management. You are not concerned with the cultural aspects of the issue, only the scientific evidence. As a result of your studies you have concluded that road building for logging the steep terrain will cause serious erosion that cannot be stopped. Fish spawning and rearing habitat will be destroyed forever.

When planning your three minute presentation consider the following:

1. The proposed logging plan is not sound. The terrain is too steep.
2. Your people depend on fish in the Klamath River basin. Clearcutting on National Forest Service land will effect Native fisheries. Clearcut logging on reservation land will be devastating.
3. The estimated per capita payments are small compared to the money the long term fish industry will provide tribal members through sale of salmon and tourism.



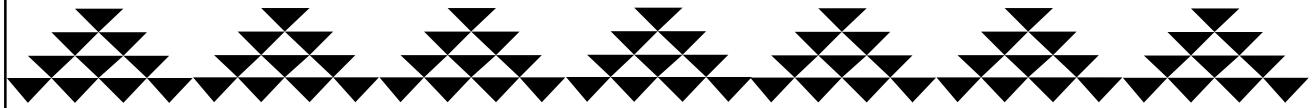


## Indian Medicine Doctor

Some of the plants you need to carry out your duties as an Indian Doctor grow in the forest considered for logging. You are opposed to any type of logging. You have seen the practices of the Forest Service and the Klamath River Logging Company destructive to the health of the forest. You do not believe that either the Forest Service or the logging company will not destroy the plants on which your people depend.

When planning your three minute presentation consider the following:

1. Indian medicine is important to the well being of the tribe, both physically and spiritually. You must be allowed to gather the plants you need to make your medicine.
2. The plants used in your medicines must be allowed to grow without disturbance so that you can pass your knowledge on to future Indian doctors.
3. Even western medicine has realized the importance of the yew tree for providing cancer fighting taxol. The forest in question has many Pacific Yew trees. Clearcutting would destroy this resource.





## Per Capita Tribal Member

Your husband was a timber worker killed while working in the forest sixteen years ago. You have not had full time employment since his death. Nevertheless, you have been able to raise two children who are still living with you. Although their jobs help meet the household needs, per capita payments are an important income. You rely on checks at least twice a year. You are not concerned about the source of the money. The reservation land that would be logged is far from your home. Cultural impacts of the logging do not concern you much. You see the trees as a resource owned by the tribe. The trees should be used for the financial benefit on tribal members.

When planning your three minute presentation consider the following:

1. The trees will provide per capita payments of \$4,000 for two years.
2. You want the money so that you can visit your sick brother in New Mexico.
3. The trees belong to the Tribe and should be cut down so everyone can have the money. Why leave the trees standing just going to waste?





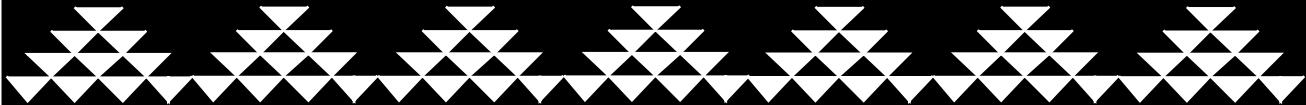
## Non-Indian EarthFirst! Member

The forest cannot speak for itself, so you must. Remember The Lorax? (Lesson #11). The issue to you is the health of the planet. The forest is healthy. As long as the forest is healthy the earth will be protected. Logging the forest will cause the forest to be ill, changing it into nothing more than a tree farm. Clearcutting will destroy the forest and it will never be able to be well again. You are strongly opposed to any cutting and are willing to stand in the way of the logging trucks.

When planning your three minute presentation consider the following:

1. Only one percent of the original old growth redwood forest remains.
2. Money from logging will provide per capita payments and income to workers for only a short time. Then the money will run out. What then?
3. The earth needs healthy forests in order to survive. Most of the forests in Northern California have been changed for the worse through logging. This forest should be saved in order to maintain a healthy planet.
4. The forest has a right to exist without human interference. The trees should be left alone, and nature alone should be allowed to manage the forest.





## Forest Advisory Panel Members

The decision rests with you: Should the 640 acres of National Forest land be logged, and if so how? It is up to you to recognize your own special interests and the interests of each group making statements before the Panel.

1. What criteria are you going to use to analyze the statements made by the citizens? Make a list of these.
2. How will you take into consideration the feelings of the local citizens in making your decision?
3. What are the advantages and disadvantages of each presentation? What, if any, other options could you consider?
4. What factors besides the local citizen reaction will you be considering as you work toward a decision?
5. 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 it has presented its point of view. When all groups have completed their presentations, consider alternatives. The solution the Panel chooses must be acceptable to the majority of the Panel members.



# LESSON

43



## *Recycling 101*

### **Major Concept**

How to set up a recycling program.

### **Objectives**

As a result of this activity students will demonstrate:

1. an increased awareness of the need for recycling in their lives, classroom and school;
2. an understanding of the types of recyclable products; and
3. a desire to continue recycling efforts beyond the classroom.

### **Background**



Recycling programs may seem like a giant undertaking. The trick is to start small, have a collection point to deliver your recyclables on a regular basis, and to enlist proponents of devoted students and teachers.



### **Procedure**

Students begin by setting up collection boxes for used writing paper in all of the classrooms. A collection drive for certain recyclables, such as aluminum, could be used as a fund raiser for a class trip. You might organize a competition between grades for the most recyclables collected, and offer a prize to the winning grade. Be sure you have suitable markets for your recyclables before you begin a collection program! Find out exactly what kinds of material each market will accept.

Have the students record the weekly or monthly results of their program. Record and graph the reduction in volume of total solid waste and the amount of glass, paper, cans, or other materials recycled.

The program can also be a money maker, especially with certain materials, such as aluminum. Follow

---

and record the fluctuations in the selling price of the recycled materials.

Research the reasons behind these

changes. Calculate how much money is earned by your recycling program. You might also have students keep a running tally of the number of trees they have saved by recycling paper.





# *Recycling 101 and Beyond*

## **Major Concept**

Recycling activities should take place every day.

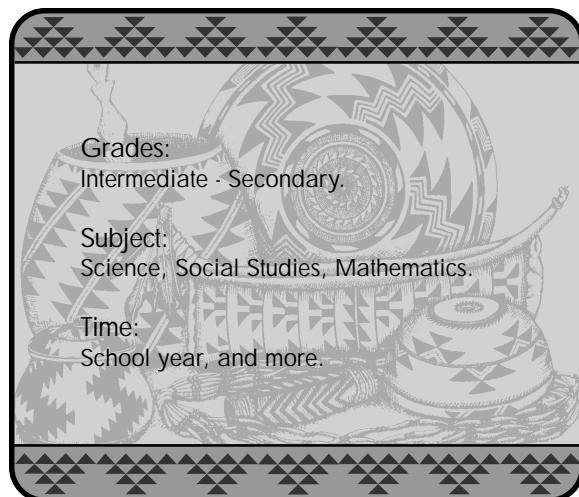
## **Objectives**

As a result of these activities students will:

1. increase their awareness of recycling in their community and get involved in recycling efforts outside of school,
2. educate the community about solid waste management, and
3. develop research skills to determine the contributions that business and government can make to the recycling effort.

## **Background**

Recycling programs may seem like a giant undertaking. The trick is to start small, have a collection point to deliver your recyclables on a regular basis, and form an initial cadre of devoted students and teachers.



## **Procedure**

Students could begin by setting up collection boxes for used writing paper in all of the classrooms. A collection drive for certain recyclable, such as aluminum, could be used as a fund raiser for a class trip. You might organize a competition between grades for the most recyclables collected, and offer a prize to the winning grade. Be sure you have suitable markets for your recyclables before you begin a collection program! Find out

---

exactly what kinds of material each market will accept.

Have the students record the weekly or monthly results of their program. Record and graph the reduction in solid waste and the amount of glass, paper, cans, or other materials recycled.

The program can also be a money maker, especially with certain materials, such as aluminum. Follow and record the fluctuations in the selling price of the recycled materials. Research the reasons behind these changes. Calculate how much money is earned by your recycling program. You might also have students keep a running tally of the number of trees they have saved by recycling paper.



Do businesses in your community recycle their paper? Conduct a survey of local merchants and businesses to determine the amount and types of waste they produce and whether they are currently doing any recycling. Supermarkets or chain stores are a good place to start since many of them bale and recycle their cardboard wastes. Restaurants may also recycle some of their wastes. If a nearby government building or a private office building has an office paper recycling program, you may want to plan a class trip to see how it works.

Discuss ways that businesses and the government can contribute to the solution of the solid waste problem. For example, many businesses and commercial enterprises recycle their office paper, corrugated cardboard, glass, and aluminum. The U.S. EPA has a program to recycle all of its office paper and newspaper.

Plan a science fair that will present information to the school and community on how to reduce the amount of waste they generate, as well as how to recycle waste from the home and school. Begin by brainstorming with students about the things that

they can do to solve the garbage problem based on what they have learned.

The fair can include many of the demonstrations used throughout this guide on the sources of pollution, making recycled paper, setting up a compost pile, and the recycling processes of different types of materials. It can also include displays of how to prepare and separate materials for recycling and booths on shopping and designing packaging for waste reduction. You may wish to have some students put on skits that deal with themes of source reduction and recycling, such as the waste conscious versus the wasteful way to shop for food, change oil, and prepare a meal. This would also be a good opportunity to perform the skit "Throwaway Three," located at the back of the guide.

Encourage your students to think of the fair as a learning opportunity for the entire community.



# The Great Can Crusher Contest

## Major Concept

Simple machines are used in the recycling process.

## Objectives

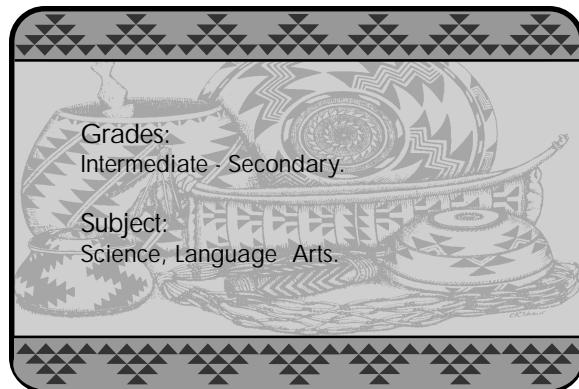
As a result of this activity students will be able to:

1. describe the type of simple machines and forces required to compact recyclable cans;
2. explain the purpose of compacting materials; and
3. manipulate materials with tools and to solve mechanical problems.

## Background

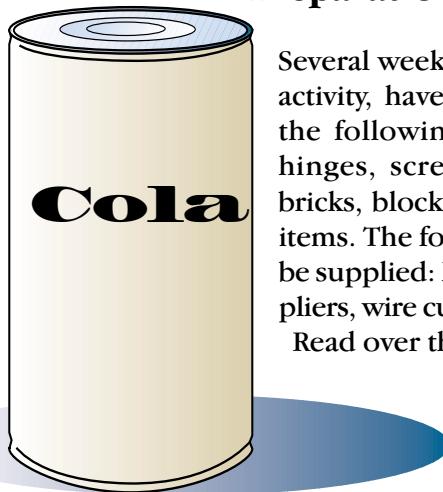
Students cooperate in groups to develop and implement plans to build a can crusher from a variety of construction materials brought into class. Machines are tested and judged. Students write an evaluation of the procedure.

This activity is compatible with initiating a recycling drive



for aluminum cans at your school. The activity itself will draw attention to the drive. The projects constructed will aid in the storage of cans before they can be taken to a recycling center.

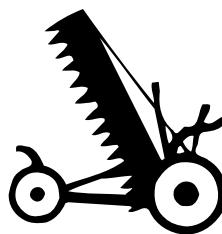
## Preparation



Several weeks prior to conducting this activity, have students begin bringing the following materials: rope, wire, hinges, screws, nails, wood scraps, bricks, blocks; and other construction items. The following tools also need to be supplied: hammer, saw, screwdriver, pliers, wire cutters, and aluminum cans. Read over the activity so you will gain a sense for the materials that may be useful and items which would not. You may want to seek

---

help in acquiring materials, as well as guidance, from the industrial arts teacher or school custodian. Parents or other community members may be helpful for obtaining materials. For the sake of safety, you should have students construct their projects in a room where parent volunteers or others are on hand to supervise. Also useful in this activity, for Steps 2 and 5, are pictures of waste management machines, particularly can crushers and compactors. You may want to have copies of these on hand for each group.



## Procedure

1. Organize the class into small groups. Refresh their memory how various simple and compound machines make work easier.
2. Show the students four clean empty aluminum cans. Ask a volunteer to crush three of the cans with his or her foot. Compare the space taken up by three crushed cans with the space taken up by three cans not crushed. Discuss how compaction is important for home storage and for recyclers (less storage space required, easier and cheaper to ship). Discuss the work needed to crush a can. Show students the pictures of can crushers. Have students identify what is involved.
3. Have students create a rubric which can be used to evaluate the success of their prototype.
4. Examine materials brought into class. Allow several class periods for each group to work on each phase of the process. They may think of more materials (which can be brought in at a later time) to help improve their machine once the construction phase is begun.

## Design Phase

- A. Discuss different types of designs by thinking about simple machines combinations of machines which could be made from the materials brought to class.
- B. Draw a rough sketch design of the machine which everyone in the group can agree on. Make a list of items which are needed to make the machine. Make sure these items can be found at school or brought from home.
- C. Write an explanation of how the crusher works. Identify the type of simple machine employed (i.e. lever pulley, screw) and the direction of forces.

## Construction Phase

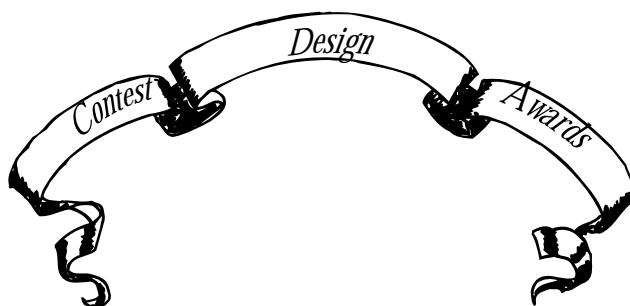


- A. Draw and label the exact dimensions you want the can crusher to be.
- B. List materials needed for crusher and tools needed for assembly.
- C. Plan assembly order. (How do you put it together: in what sequence stages?)
- D. Construct the crusher according to your design.

## Test Phase

Test crusher and repair or redesign any flaws before the final contest. Write step-by-step instructions for using can crusher.

5. Hold a contest and judge the entries.



**Novel Award** (most unusual machine);  
**Speed Award** (most cans crushed in one minute);  
**Complex Award** (machine made up of the most simple machines);  
**Resiliency Award** (the can crusher that can take the most abuse without breaking);  
**Efficiency Award** (needs least work [energy] to crush a can); and  
**Overall Award** (the crusher that excels in the most categories).

Adapted from *Super Saver Investigators*, Ohio Department of Natural Resources.



# LESSON

# 46



## Clean-up Crew

### Major Concept



Some items will decay and return to the soil, while others will not.

### Objectives

As a result of this activity students will demonstrate:

1. a knowledge of the mechanics of decomposition; and
2. the ability to predict the decomposition rate of various consumer items when disposed.

### Background

Soil is made up of decaying organic matter and rock. We also find water and air mixed in soil. You can make soil similar to that of nature by composting garbage. This is a fun activity of discovery. Have students predict the rate of decomposition!

Grades:  
Primary - Intermediate.

Subject:  
Science.

Time:  
One class period to set up.

Materials:  
Two large plastic garbage bags.  
Various items that will decay.

### Procedure

#### Activity 1.

You will need two plastic bags, yard clippings, cafeteria waste (no meat), scraps of paper, a shovel full of soil, and sticks. Put the bags together to make a double-strength plastic bag and insert all ingredients. Moisten contents so they are like a damp sponge. Tie the top and find a place to store the compost. Open the bag once a day to stir so air will get to all part of the garbage. Do this everyday for at least two weeks.

#### OBSERVATION:

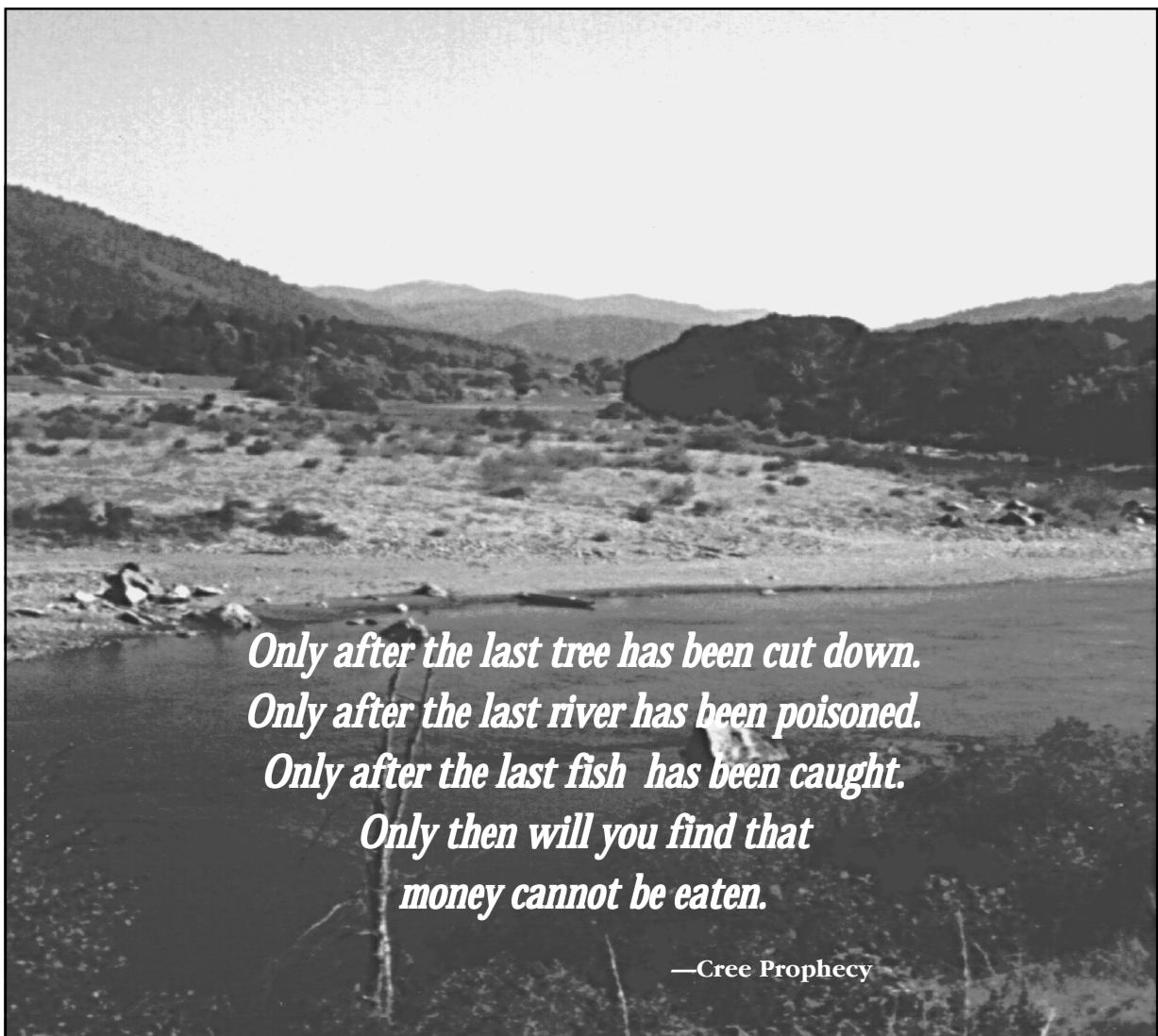
What is happening? Why?

---

## Activity 2.

Make a graveyard of a variety of different materials, such as metal, glass, plastic, rubber, vegetables, bone, wood, paper, rope, leather, and feathers. Challenge students to bring litter they encounter on the way to school. Bury each item in a separate hole, all at the same depth. Once a week dig up the items and record how fast and in what ways each is decaying.

Adapted from, *The Green Box*, Humboldt County Office of Education, 901 Myrtle Avenue, Eureka, CA 95501, 1989.



*Only after the last tree has been cut down.  
Only after the last river has been poisoned.  
Only after the last fish has been caught.  
Only then will you find that  
money cannot be eaten.*

—Cree Prophecy



# School Composting

## Major Concept

Waste materials can be transformed into products useful to the soil.

## Objective

As a result of this activity students will be able to design a composting bin that can be used by their own family.

## Background

Composting is the process of breaking down organic material into rich soil amendments. These amendments can be added to a vegetable or flower garden increasing its productivity. Composting has the benefit of reducing the amount of waste people transport to a landfill. It is a cost saving strategy for the individual and for society.

California mandated a reduction of 50% of waste going to the landfills by 1997. Locally, the life expectancy of any landfill is finite. Composting organic waste is part of the solution to the landfill problem. Keeping compostable materials out of the local landfill will reduce environmental problems such as leachate, methane gas buildup, and space scarcity. Additionally,

Grades:  
Primary - Secondary.

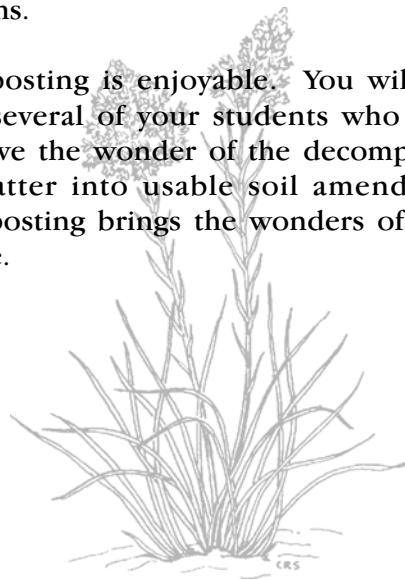
Subject:  
Science, Mathematics, Social Studies.

Time:  
One class period to set-up. The remainder of the school year.

Materials:  
Commercial or homemade composting bin.  
Space on the school site to maintain an active compost pile.

keeping food scraps out of garbage disposals eases the load on sewage plants and septic systems.

Composting is enjoyable. You will likely find several of your students who like to observe the wonder of the decomposition of matter into usable soil amendments. Composting brings the wonders of nature to life.



# Organic Material and Soil Organisms

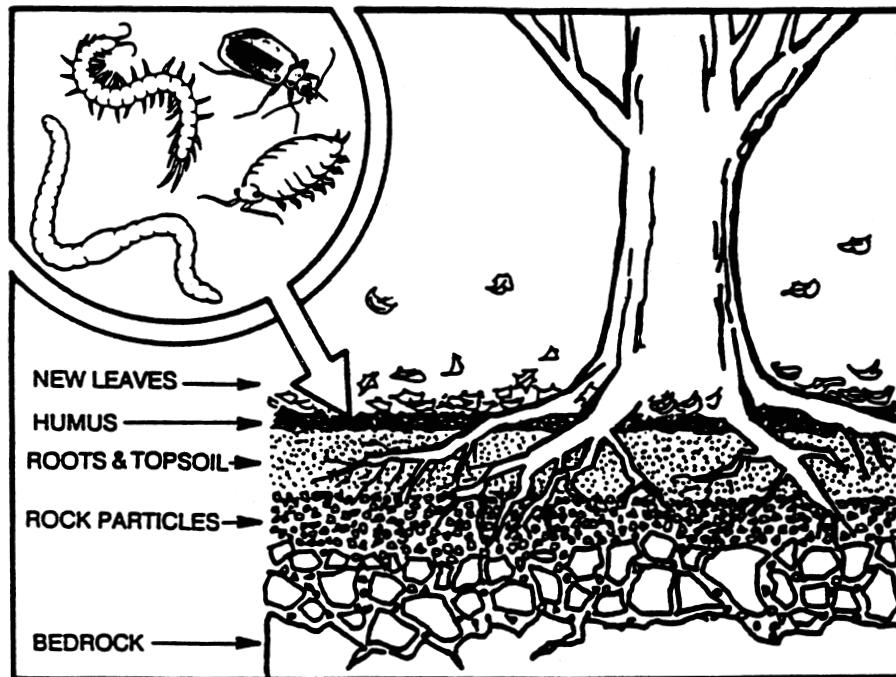
## The soil

Soil is made up of five components: sand, silt, clay, organic material and soil organisms. Different soil types have different proportions of these components. In general, soils high in organic material house large numbers of soil organisms and are very fertile.

Soil organisms are classified as decomposers since they eat dead organic material. (Organic material is anything composed or derived from living organisms.) There are many kinds of decomposers. Some we can see like worms, sow bugs and beetles but most like bacteria and fungi are too small for our eyes. A tablespoon of healthy soil can contain many billions of bacteria and fungi. Healthy soil is home to so many organisms that we could literally say the soil is alive. Plants are dependent upon life in the soil to keep the nutrient cycle going. Here is how it works.

## Digestion

As decomposers eat dead organic material, it passes through their system and is digested. The digestion process causes chemical changes in the material, allowing plants to use nutrients that were trapped in the organic material. Minerals trapped in rocks, are also made available to plants, as organic acids. Produced by the decomposers, these organic acids slowly dissolve the outer layer of the rocks. The product resulting from this digestion process is called humus.



Decomposers need dead organic material on which to feed. Plants need decomposers to convert dead organic material into humus. Humus contains the nutrients and minerals plants need to live.

---

## Procedure

You can successfully compost school lunch room and school ground clippings in a ditch or a heap. Heap composting is simple. Materials are maintained on the ground in a pile. The area needed is approximately eight feet square. You will want the pile to be about five feet high. The advantage of heap composting, or composting in a ditch is that you can fill an area that has been excavated and you want to reclaim.

Compost bins merely organize materials for you. If you choose to use a bin several options are available. Stylish commercial varieties can cost hundreds of dollars. Homemade compost bins can be constructed of discarded material. These materials can include wood, plastic, or metal screen. They can range from large plastic trash cans to discarded wooden pallets. Wood units are low-cost and allow you to expand into a system of two or three bins. The advantage of a system is that you can "turn" your composting material from one unit to the next, thereby exposing inside matter to sun and air.

The first time you fill your bin or establish your heap it will seem like you have too much material. Grass, for instance, is 85% water. In a short time your material will dry, and the pile will compact in volume 35 - 50%.

Whether you are using a bin or a heap you will need to keep your mixture of composting materials at a ratio. You will want about 33% green and 66% brown materials. The green things provide nitrogen, and heat, to the system, the brown provides carbon. If you do not have enough brown material, shredded newspaper will work. Include in your compost of grass, leaves, newspaper, etc., items like: non-animal food scraps from the cafeteria and student lunches, fireplace ashes, bone meal, manure, and water. Keeping the com-

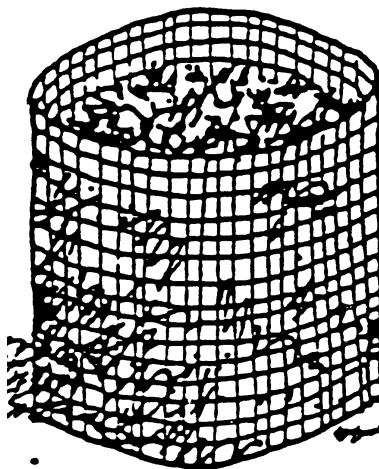
post damp is essential for the process. Yet, too much water will cause decomposition to slow. During rainy times, keep the compost covered. Bury food waste in your compost. This will keep animals, unwanted insects, and odors away. A well tended compost bin or heap will not produce noxious odors. If your mixture gets unbalanced and begins to smell add brown materials such as leaves, straw, woody materials, or dry grass. Mix the materials and the odors will go away.

Keep your bin full. Add to it every school day. The organic materials will greatly shrink in volume, and in six months the bottom of your pile will have a layer of rich, crumbly compost. There are two methods of adding materials: the layering method, and the mixing method. The layering method requires you to save-up materials until you have sufficient quantity to place in the bin. After you have saved the compostables layer them as follows: dry leaves (or shredded paper), food scraps, green school ground clippings, manure, food scraps, leaves, and then some saw dust. As this decomposes place another series of layers on top when you are ready. The mixing method does not require you to save materials until such time you have enough to layer. The layering method requires you to keep mindful to keep a balance of 50% brown and 50% green at all times. Using a pitch fork simply mix the compost on a regular basis. This can be done by turning over the compost into another pile. The goal is to blend wet and dry materials and brown and green materials. Fresh materials, like lunch room scraps, can be added to the center of the pile as you turn it.

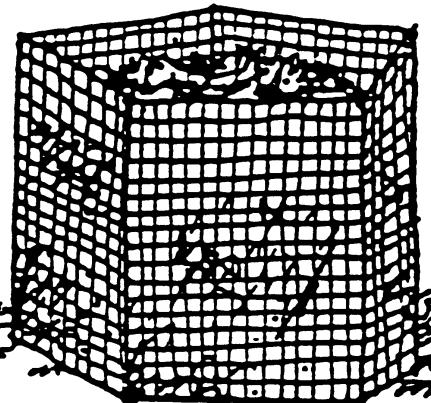
Regardless of the method you use, layering or mixing, you will discover dark, crumbly compost at the bottom of your system after about six months. This compost can be mixed with worm castings to make a wonderfully rich soil amendment. This can be added to your school garden, and you can observe the growing cycle continue.

---

## Wire Mesh Compost Bins



Circular Bin



Five-Panel Bin

---

### Activities

Several science and mathematics activities can be designed around school composting efforts. The following are some ideas:

1. Vary the ratio of green material to brown material. How quickly is compost produced?
2. Try including small twigs and stems. How quickly do they decompose?
3. Test the temperature of the compost pile. Draw a compost profile or map of the pile.
4. How hot will the center of the pile become? What is the uppermost temperature limit? At what point does decomposition stop?
5. Bury various types of cafeteria waste in the pile. Which items break down the fastest?
6. Build two compost piles, one that is aerobic (receives air because you turn the material) and one that is anaerobic (does not receive air, do not turn the material). Which pile decomposes quicker?
7. Study the organisms that inhabit the compost pile. Draw their anatomy. Make measurements of their bodies. Investigate their role in the decomposition process. Map the compost pile relative to where populations of organisms live.
8. Investigate the interactions of the organisms in the compost pile. Make comparisons to human communities.

---

### Resource

*Backyard Composting, Your Complete Guide to Recycling Yard Clippings*, (1993). Harmonious Press, POB 1865-100, Ojai, CA 93024.



# Vermiculture

## Major Concept

Natural processes are the best for recycling waste.

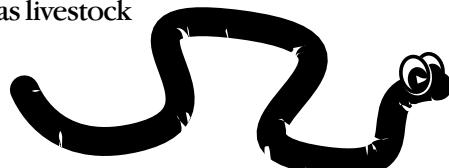
## Objectives

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

1. role of worms in decomposing waste; and
2. value of worms in a home integrated waste reduction program.

## Background

More food waste is sent to the Cummings Road landfill than any other item except wood waste ash, in Humboldt County. The County's 1990 Waste Generation Study estimated more than 13,000 tons per year of food waste disposed of at the landfill. This accounts for 7.64% of the total. An additional 3,400 tons of food waste is diverted for use as livestock feed and by-products. By comparison, only 1,200 tons of old tires, 7,900 tons of all plastics, and 8,400 tons of lawn waste were disposed during the same time.



Grades: Primary - Secondary.

Subject: Science, Mathematics, Social Studies, Language Arts.

Time: One class period to set-up. The remainder of the school year.

Materials: Dark colored plastic container 1' deep x 3' long x 2' wide. Newspaper, water, food scraps, one pound of red worms.

Food waste is a leading contributor to the amount of waste material produced by schools, second only to paper. Although much of the paper is reusable and recyclable, food waste must usually be dealt with on-site, as collection and centralized processing does not yet exist in Humboldt County.

Composting with worms (vermicomposting) provides an excellent opportunity to involve students in a truly "hands-on" learning experience which will help to reduce the amount of food waste sent

to the landfill. It will also teach students about the fascinating world which exists in the soil.

Worms are great at composting. One pound of red worms

equals about 2,000. Two thousand red worms can eat about 1/2 pound of food waste each day. Worms can eat half of their body weight each day.

---

Worms need an environment that has approximately the same moisture content as their bodies, 75 percent. This is regulated by weighing the shredded newspaper and adding three times as much water.

.

---

## Procedure

Fully open sheets of newspaper and tear lengthwise down the center; then gather two halves and tear lengthwise again, and repeat this process five or six times for each section. You should have strips that are one to three inches wide.

You will need from nine to fourteen pounds for the bin. Measure newspaper on a household utility scale or on a bathroom scale by first weighing yourself and then weigh yourself holding a bag full of dry newspaper strips. The difference between the two weights is the weight of the newspaper.

Calculate the amount of water needed by multiplying the weight of the newspaper by three. Remember that a pint of water weighs a pound, so a gallon of water weighs eight pounds.

Place about half of the newspaper in a mixing container, add about half of the required amount of water to dampen the paper. Then add two handfuls of soil and the rest of the newspaper and water. Mix well, and then empty into the worm bin and distribute the newspaper evenly.

Now, gently place the worms on top of the bedding, spreading them around evenly. Keep the bin uncovered - within a few minutes, the worms will move down into the bedding to avoid light. Worms prefer darkness; even though they have no eyes, they do have sensory cells on their skin which detect light. Note: Despite the holes in the bottom of the bin, the worms will stay in the bin because they do not like light.

Just about any waste left over from school lunches can be fed to the worms; these include: bread, lettuce, tomatoes, apple cores, bananas, eggshells, grains, celery ends, and orange peels. They also enjoy food stuff from the teacher's lounge, like: coffee grounds, and tea bags. Things that worms cannot eat are animal products: meat, bones, mayonnaise, fish, peanut butter, candy, plastic wrap, rubber bands, etc.

It is possible to overload the system. Bury food material in a pattern. This will allow you to keep track of how much food you are providing the worms and where it is placed. Food can be added daily, weekly, or monthly. Remain consistent.

Place a sheet of newspaper over the top of the bin. This discourages undesirable organisms from entering the bin; particularly flies. Place the bin in a cool place out of direct sunlight. Keep the lid tightly shut.

After a period of three to six months, depending on the size of the container, you will notice that the food and bedding in the worm bin have almost completely been transformed into worm castings, the nutrient-rich waste material that worms excrete. Now it is time to harvest the humus, change the bedding, and scalp your worms.

Scalping worms is the terminology used by vermiculturists to describe separating worms from their castings. Spread out a drop cloth in an open area. Dump the entire contents of the bin out onto the drop cloth. Sort the materials into several cone-shaped piles. Worms dislike light, so they will burrow deep into the pile to avoid it. Scoop off "scalp" materials from the tops to the piles - you will be able to watch most of the worms bury themselves deeper into the pile. Put the worm castings (humus) in a container that can be mixed with compost and used in gardening.

When you reach the bottom of the piles, you will find a lot of worms. Put them back in the worm bin. When all of the piles are sorted, add the uncomposed food waste and old bedding to a stock

---

of new bedding. Dump in any additional worms and begin the process over.

You will notice that your bin will have other inhabitants than your red worms. This is usually normal and cannot be avoided even if you keep your bin indoors. The creatures that are beneficial include: molds, bacteria, sow bugs, beetle mites, white worms, snails and slugs, flies, round worms, and millipedes. The creatures you do not want in your bin are: flat worms, ground beetles, centipedes, ants and pseudo scorpions. If your bin gets infected with undesirables you will need to start over. Don't worry, it rarely happens, even if your bin is the outdoor variety.

---

## Activities

Several science, mathematics, social studies, and language arts activities can be designed for the benefit of your students. The following are some recommendations:

1. Use the Sample Vermicomposting Data Sheet as a springboard to deeper investigations.
2. Take the temperature of the worm bin once a week to determine the variations that occur while food is being composted. Use a thermometer which can measure temperatures up to 170° F. How much time does it take to observe a noticeable change in temperature?
3. Notice where worms tend to congregate - do they seem to prefer certain foods to others? Do smaller pieces of food waste tend to break down faster than larger ones?
4. Use pH paper to test the acidity of the worm bin once per week. Are there changes based on the foods added?
5. Bury different materials in different spots and chart their rates of decomposition; i.e., does a

banana peel tend to decompose more or less quickly than a coffee filter? Bury non-foods, such as a plastic bottle, and chart its rate of break down. Students can measure these variables:

- a. temperature over time;
  - b. acidity of material over time;
  - c. number of worms over time;
  - d. weight of food waste as it is added;
  - e. decomposition rates of food waste buried in a specific pattern and charted
  - f. amount of frequency of water added; and
  - g. compare the rates of decomposition of a banana peel vs. coffee grounds.
6. Study the life cycle of the red worm. It goes from cocoon to hatchlings, to mature breeding adults. Investigate how long the cycle takes. Predict how many worms can be born in a year in your bin.
  7. Study the anatomy of a red worm. Why is it so efficient at converting food waste?

---

## Resources

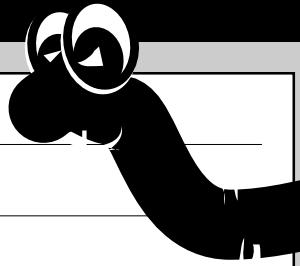
*Worms, worms, and more worms! Mr. Triskas' 4th grade vermiculture project, (1994).* Pacific Union School, Arcata, CA 95521.

*Backyard composting, your complete guide to recycling yard clippings,* (1993). Harmonious Press, POB 1865-100, Ojai, CA 93024.

Appelhof, M. (1993). *Worms eat our garbage,* Flower Press, 10332 Shaver Road, Kalamazoo, MI 49002.



# *Sample Vermicomposting Data Sheet*



Date bin was set up: \_\_\_\_\_

How many worms? (in pounds or number of worms): \_\_\_\_\_

Kind of bedding used: \_\_\_\_\_

How many people will be contributing to the food waste? \_\_\_\_\_

On a separate sheet of paper, draw the worm bin, including its dimension, and assign plots to its surfaces so that you can track the decomposition of food placed in each numbered area.

Date	Day	Weight of food	Total food wt. to date	Amount of water	Buried in site #	Notes

Harvest date: \_\_\_\_\_ Total days: \_\_\_\_\_

Worm weights or numbers: \_\_\_\_\_

Total weight of food waste buried: \_\_\_\_\_ Weight of uneaten food: \_\_\_\_\_

Average weight buried per day: \_\_\_\_\_ Average temperature per day: \_\_\_\_\_

Average temperature where bin is kept: \_\_\_\_\_

Temperature range where bin is kept: \_\_\_\_\_





# *School Gardening*

## **Major Concept**

Gardens provide a feeling of community that enhance the over all school environment.

## **Objective**

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

1. describe the life cycle;
2. demonstrate an understanding that soil is living; and
3. show a willingness to work with others in a community effort.

## **Background**

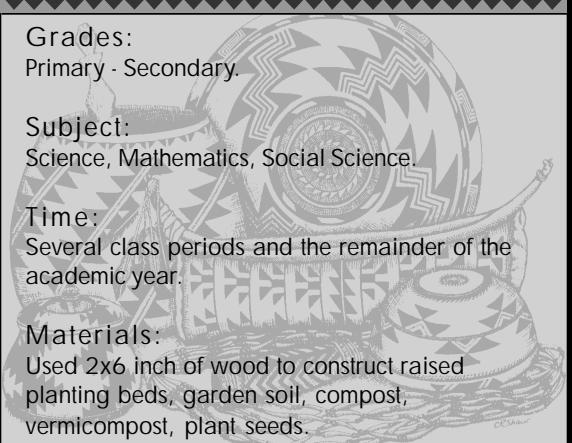
School gardens serve useful purposes. They provide an opportunity for students and teachers to work together in a unique hands-on experience, they provide real-world examples of classroom content, and they give opportunities for schools to grow plants that can be sold to raise money. Foremost, school gardens provide a sense of community, camaraderie, and well being.

Grades:  
Primary - Secondary.

Subject:  
Science, Mathematics, Social Science.

Time:  
Several class periods and the remainder of the academic year.

Materials:  
Used 2x6 inch of wood to construct raised planting beds, garden soil, compost, vermicompost, plant seeds.



This activity is designed to build upon and be enhanced by activities 48 and 49. Products from composting mixed with worm castings from vermiculture are intended to enrich the soil used in the raised garden beds.

## **Procedure**

It is imperative that students are actively involved in the process of deciding what should be grown in their garden. Ownership in the project will decrease the likelihood of vandalism. Therefore, it is wise to have as many classrooms be involved in the process as logistically possible.

---

Let the students decide the type of garden they wish to tend. Vegetable gardens may need to be cared for during the summer months, when harvesting often occurs. This should be kept in mind. Flower gardens are useful for raising money in the spring when plants grown in peat pots can be sold to friends and neighbors.

Make sure adequate garden soil is used in the project. A mixture of sand, earth, manure, peat moss, and amendments (lime, bone meal, etc.), should make up the foundation of the garden. Compost from your compost bin and worms from your vermiculture project will enhance the fertility of the garden.

---

## Activities

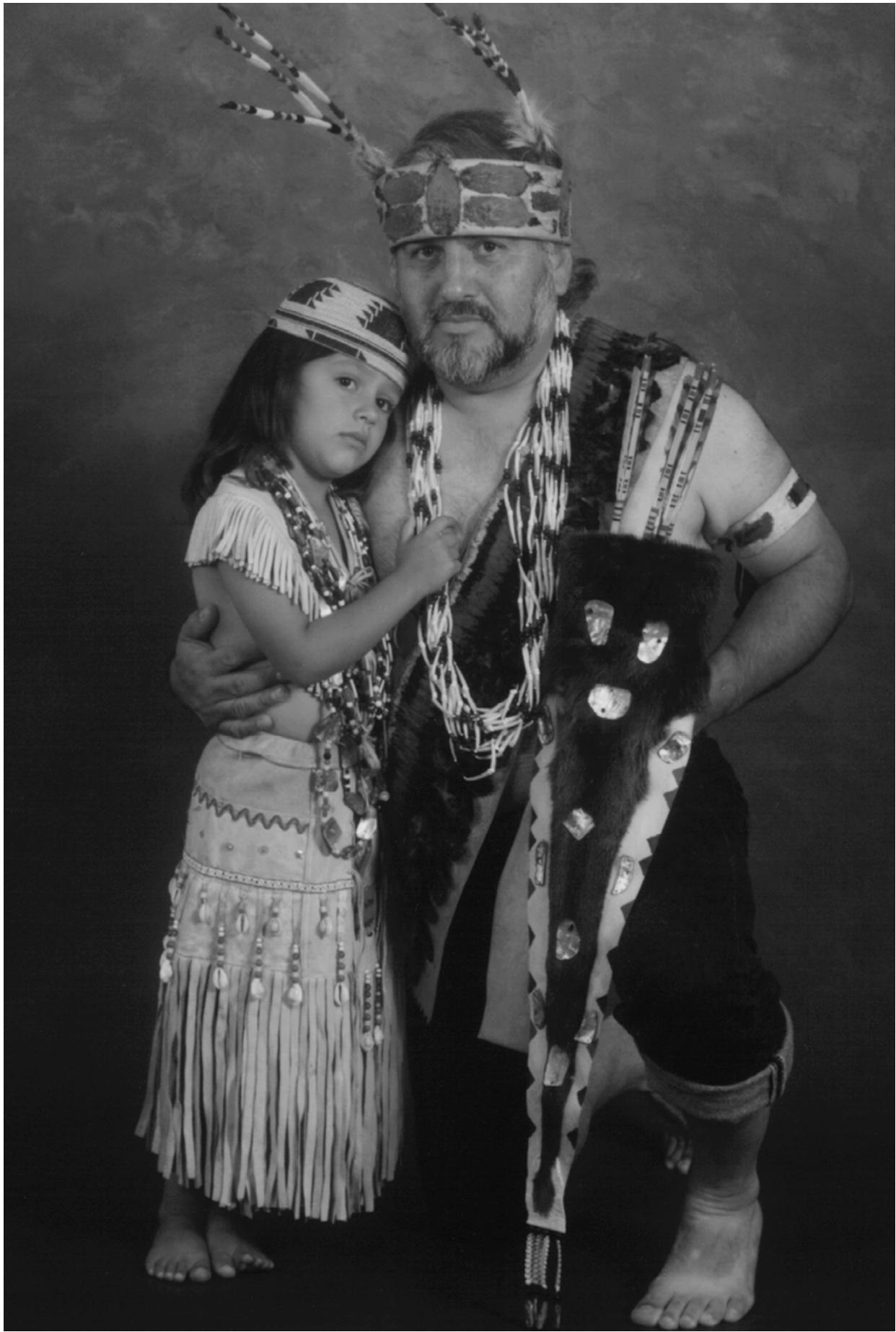
If you will have difficulty preparing a garden because of hard soil, consider constructing

raised beds. Raised beds can be constructed with 2x6 recycled lumber. Nail four pieces together in order to make a box. Place the frame on your garden site. It can even be on concrete! Fill the planter box with an appropriate garden mixture.

School garden projects can be very therapeutic for students. Working in soil and tending plants can have a centering effect on participants. Use the garden on a regular basis to effect discipline and morale.

Many schools have adopted class buddies—older students are paired with younger. Together they tend a selected part of the garden. Older students share understanding of plant growth and garden dynamics. Younger students provide added excitement and focus for exploration.







# *The People Shall Continue*

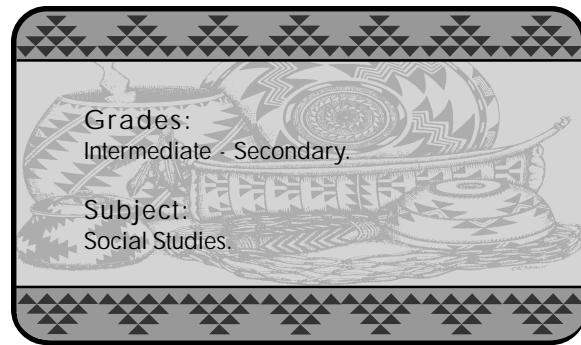
## **Major Concept**

Every individual must possess an understanding of community affairs, past and present, and be willing to act on the basis of that knowledge.

## **Objectives**

As a result of this capstone activity students will:

1. demonstrate a willingness to work individually and collectively toward achieving and maintaining the dignity of human life and the environment.;
2. gain valuable insights into the historical, social, religious, political, and economic events that shaped conditions the of their world;
3. realize that people often make choices that condone prejudice, discrimination and hatred.
4. understand that silence and indifference to suffering are forms of complacency that perpetuate human rights violations.
5. be able to state that human rights and dignity need to be cultivated and protected;



6. be able to talk about the values of pluralism and the consequences of racism; and
7. realize that it is the responsibility of every citizen to recognize threats to the sanctity and dignity of life and to take the necessary action to prevent the violation of human rights.

## **Background**

The life that we have come to know in this country was built upon what the land held for us and how we came to understand ourselves in relationship to it. The magnificent forests, the rich bottom lands, the lush grasslands of the prairies, the many rivers and lakes, the great deserts and towering mountains, each in their own way contributed to our fundamental concept of self, family, community and nation. Inherent in the weather, geology, soils, plants and wildlife of each particular region of this country is a different way

---

of living in the world, a unique and specific knowledge of self, inseparable from the land.

This is the place that we call home, and deeply-rooted within the idea of home and family is the notion of reciprocity, that we each contribute to the family in a manner meaningful to that which we receive. To be a part of a family one must participate and take an active interest in each of its members. We must communicate, but most importantly we must listen. We must take account of the land that is our home, ponder its rhythms and contemplate its indigenous knowledge. Otherwise we are merely wanderers; strangers to the land upon which we live, and incoherent in our existence.

The basic fact of the American landscape is how it has been changed in the past 500 years. When Columbus landed in 1492, North America was ecologically intact and inhabited by at least twelve million people. Within four centuries most of the old growth timber had been removed, and the once diverse populations of plants and animals had either been greatly reduced or eliminated from their former ranges. According to official census, the number of Native Americans was reduced to 237,000 people by 1900. This 98 percent erosion of Native populations corresponds almost exactly to the expropriation of approximately 97 percent of native lands by 1920 (Churchill, 1994:38). This basic fact of genocide and appropriation was repeated throughout the New World and continues to define Western and Native relations in modern times.

Few people are aware of their relationship to Native Peoples, past or present, but if our most essential relationship is to the land, then we can not escape the fact that our fundamental identity as a culture is then inseparable from our relationship with Native Peoples. Native Peoples embody the land upon which live.

---

*When Columbus landed in 1492, North America was ecologically intact and inhabited by at least twelve million people.*

---

They exist as an expression of their environment and revere nature's rhythms in their daily lives and ritual. There is no part of America that does not bear witness to their presence. In the east: Cherokee, Susquehanna, Delaware, Onondaga, Abenaki, Catawba, Seminole, Osage and Mohican. In the Great Lakes: Ojibwa, Huron, Chippewa, and Ottawa. In the plains: Crow, Assiniboin, Mandan, Shoshone, Kiowa, Pawnee, Arapaho, Kansa, and Shawnee. In the south west: Apache, Hopi, Navaho, Comanche, Mescalero Apache, and Pima. To the Northwest: Nez Perce, Salish, Yakima, Coeur d'Alene, Snuqualmi and Chehalis. Further south: Tillamook, Siuslaw, Coos, Tolowa, Yurok, Wiyot, Hupa, Karok, Miwok, and Chumash. In the Sierras and Great Basin: Modoc, Wintun, Shasta, Mono, Yana and Yokuts. More than a thousand different nations each with their own distinct language and culture, reflecting a thousand ways of knowing and living with the

land (Lopez, 1992).

At the center of Euro-American and Native relationships is the land. Both cultures needed the land to survive. Native cultures lived within nature and revered it as the most fundamental fact of life. A gift from the Creator to be nurtured and celebrated. Europeans saw nature as having no intrinsic value beyond its instrumental use as a commodity, as strictly a means to an end. They sought dominion over the land and all that lived upon it. Nature was to be subdued, and rendered "useful" from its primeval condition. Europeans perceived Natives Americans as a metaphor of the land and the wilderness that they sought to subdue. From this perspective Native peoples became merely another organic entity to be disembodied, appropriated and consumed (Drinnon, 1990).

It was within the context of these incommensurate world views that the assault on Native

---

cultures took place; patterns of destruction that represent a complimentary expression of the ideology and cultural values of the West. The popular historical record recounts this holocaust as the tragic and unfortunate consequence of the newly emerging world economic order. The destruction is perceived as disconnected events and random acts of violence committed by individuals who operated on the fringes of society's auspicious commitment to morality and freedom. However, even the popular historical record documents the indifference with which government policy was repeatedly implemented with no regard for its inevitable impact on Native Peoples.

Native Americans, who had already been defined as sovereign nations by the highest law of the land, the Constitution of the United States Government, were knowingly exposed to epidemic diseases, were deliberately poisoned by government officials, were relocated to new areas without regard to the loss of life, culture and the inalienable right of any people to self determination, were forbidden by law to speak their own languages and practice their own religions, were routinely sold into slavery well beyond the demise of slavery as a legal institution in this country, and were systematically hunted down by bounty hunters and vigilantes with the consent of local, state and national governments. Historical narratives of the day demonstrate that these genocidal acts were committed by individuals with the knowledge that they were merely augmenting official policy and that at no time did they fear being prosecuted under laws that protected other citizens.

Colonization and settlement resulted in certain consequences with a predictable loss of Native life. Settlement and aggression became synonymous acts. If consequence is the true measure of action, then the annihilation of 98 percent of the Native Americans by 1900 can only be interpreted as a genocidal act, irrespective of the purported intent of ideology,

religious beliefs or government policy. Regardless of the intent, the basic processes of genocide, appropriation, relocation, and negation of Native culture was endorsed by society. The "official" historical record stands only as an attempt to normalize the atrocity in order to avoid culpability for its continued existence in current times (Churchill, 1994).

To be accurate it must be acknowledged that there were positive exchanges between Europeans and Native cultures. Despite the considerable differences there was enough common ground to allow for some interaction. Native domesticated crops soon became staples in the diets of Europeans, in the colonies and abroad. Native language, customs, government, medicines, housing, clothing and tools were all quickly adapted by Euro-Americans for their own needs. There were immigrants who saw the wisdom of Native life and took it to heart, and it is this influence, as well as that of every other ethnic group of this land, that has made American culture distinctive unto itself, and not merely a copy of European values (Weatherford, 1991 and Johansen, 1982). However, we cannot afford to mistakenly believe that the tragic loss of so many lives was merely the unfortunate consequence of a well intentioned people, caught up in the ideology of their day. It is exactly this sort of complacency that has allowed for the continued existence of these destructive patterns of behavior and policy, in one form or another, to this day (Bullard, 1993).

---

## Procedure

Teachers should start by creating a safe learning environment where students can explore historical and current issues in a non-threatening manner. Historical issues are not isolated events. Students come from a variety of backgrounds. It is crucial that students realize that their opinions and ideas are important, and that even unpopular ideas and view

---

points can be expressed without fear of retribution. (Note: some of the activities outlined in the Crow and Weasel may be useful tools for creating a familiar and safe environment for students).

There must be a willingness to start, “where the learner is at.” The process of value development is a cyclic process of building foundational layers of *Awareness, Knowledge, Attitudes* and *Skills*, tempered with social *Participation*. Any attempt to move beyond the experience and understanding of the student can create undesirable consequences.

Education providing for value development generally progresses through five stages:

**Stage 1.** Value development in young children is based on the fulfillment of their basic needs, interactions with important role models, and the frequent repetition of certain values and skills necessary for survival. Significant institutions that influence value development are the home and school.

**Stage 2.** As the child becomes more independent of adult care he or she has a greater ability to interact with the immediate environment. The child begins to learn that others have feelings and that personal feelings are related to a sense of self-worth. The child begins to experience feelings of empathy for others and to understand that their actions may affect people around them. Issues are generally interpreted as either good or bad. Significant institutions are home, school, neighborhood, media, and religion.

**Stage 3.** The child begins to identify more with their immediate peer group and the surrounding community. They will begin to establish a personal order to a growing array of social and environmental influences. They begin to understand the necessity for group decision making. They begin to realize that problems may have more than one solution. Key institutions are home, school, primary group of

allegiance, religion, and the media.

**Stage 4.** The child begins to be able to distinguish between intuitive feelings and considered beliefs. Concerns for welfare are extended beyond personal needs and desires to include an ever growing group of alliances. Children begin to utilize reason as a means to solve problems. They desire consensus and harmony in the resolution of problems. Significant influences are home, school, groups of alliance, social and religious institutions, authors, artists, musicians, and the media.

**Stage 5.** The goal of value development is finally achieved when the child comprehends the characteristics and dynamics of universal principles such as human dignity and responsibility to family, community and the environment. The student is now able to discern the difference between personal preferences, political and social laws, cultural norms, and universal moral standards. They realize that a valid moral judgment should be based upon sound principles and not merely majority opinions. At this stage of development the student has become a conscientious moral agent who is willing to show impartial concern for all living things. They are willing to objectively study the facts and principles surrounding an issue and revise their opinion accordingly. Most importantly they are willing to act on the basis of their conclusions. They also realize the fallibility of human reason; that life is uncertain and we must always be willing to act on the basis of our own best judgment (Grover, 1991. A Guide to Curriculum Planning in Environmental Education).

---

## Activity 1

Values arise in part from feelings and emotions, therefore {value development strategies should begin with an inquiry into students intuitive feelings. Emotions and feelings will reveal the students awareness and understand-

---

ing of an issue while providing a natural starting place for academic inquiry into historical and current events. During the process of creating a safe learning environment and evaluating the students backgrounds educators will have an opportunity to formulate valuable insights about their concerns and interests. This process allows students the opportunity for critical participation in their own education while providing the teacher with an assessment of students literacy regarding a particular problem-theme.

Introduce a relevant topic by selecting a current event from newspapers, magazines, radio, TV or other sources for discussion. Be sure to select an event that is appropriate for the age and level of understanding of your students. For younger students events from the local community or even their own school may best, while older students will have a larger awareness of community, regional, national and world events. Share the subject with the class in its original form. What are their impressions? How do they feel about what they have experienced? What are the people like who are involved in the story? How are they like us? How are they different? Have you or someone you know ever had a similar experience? From these impressions you can begin to develop an understanding of the students level of awareness and the topics that might be of the most interest and concern to them.

---

## Activity 2

*Awareness* activities should engage the “whole child” in first hand investigation utilizing all their senses to explore an issue. Students should be encouraged to explore the ideas and feeling they experience in a variety of ways. Autobiographical essays, short stories, skits, round table discussions, poetry, art, and music all provide students with ways to express their experiences and share with each other what they have learned. Individuals should be

encouraged to share their experiences, but they should also have the right not to participate if they choose not to do so.

Have children conduct a simple neighborhood interview. For younger children immediate family members are the most appropriate group with which to begin their inquiries. Older children can include a wider variety of community members as their perception of self and community expands. The nature of these inquiries should focus on common perceptions and experiences of human rights issues as relates to their awareness of the problems.

---

## Activity 3

Read *The People Shall Continue* to the class. Create a discussion and record their impressions of the story. It may be useful to discuss smaller sections of the story over an extended period in order to allow time for the students awareness and understanding to develop with their knowledge of the events. Students should also be encouraged to included these impressions in their personal journals.

---

## Activity 4

Help students refine their awareness by providing a foundation of *Knowledge* to understand the issue being presented. What are the facts? Illuminate the problem-themes that arise from student’s inquiries by placing them within their historical, sociological and ecological backgrounds. Historical narratives, novels and videos may all provide sources of living history that children can directly relate their own experiences to. However, this situated study of issues should not be limited to those immediate concerns of student’s experiences, this is an opportunity to expand their perception of events and to challenge the limits of student’s awareness.

---

Have students survey the book *Native American Testimony*. Have them identify experiences that are similar and different to their own personal, family, or community experiences. Instruct the students to write a letter to the person of their choice from *Native American Testimony* expressing in prose, poetry, art or song their impressions of that persons experience and the story of their own experiences. Collect the letters, read them and write a reply on behalf of the historical figure the students have choose to write to.

---

## Activity 5

Help students acquire appropriate *Attitudes* and feelings by creating a group discussion concerning the moral principles involved in the events they have explored while relating them to their personal lives. What does it mean to be free? What is human dignity? What does equality mean? What is prejudice and racism? What are the student's personal life stories that relate to these issues. Have they ever been discriminated against? What did that feel like? Were they ever present when someone else was being discriminated against? How did it make them feel to watch this happen? What did they do? What did others do who were present?

---

## Activity 6

Vocabulary is a tool that enables students to understand the concepts that a social issue is embedded in. As new words and concepts are encountered students can be given opportunities to explore their meaning and develop there skills with dictionaries, encyclopedias, academic and scientific techniques of research and investigation, academic and creative writing techniques, art, computer literacy, interpretive skills and many others.

Help students acquire the *Skills* necessary to identify, investigate and understand the subject of inquiry. Students should be encouraged to pursue a course of creative self discovery and draw new connections with previous lessons and other related subjects. They should be encouraged to share their insights with classmates, teachers, and other significant influences in their lives.

---

## Activity 7

Help students learn through *Participation* in activities that integrate awareness, knowledge, attitudes and skills with meaningful experience.

-Students could write a letter to a local, state, national or international government official regarding an issue of interest to them.

-Students can write for additional information from a variety of government agencies and private foundations.

-Pen pals. Dialogue with students in other communities to share experiences and knowledge. The exchange of information need not be limited to writing. Art, student produced videos, stage and record a talk show radio program and interview a historic figure or the students themselves, exchange and research ideas on the Internet, these are but a few of the possible mediums of exchange.

-Have the students attend a community meeting with a parent and report their observations to the class.

-New Endings. After students have developed a firm understanding of the events and issues have them imagine how things might have been different? What factors might have enabled these different cultures to coexist to the benefit of all?

-Have students brainstorm ideas on how things might be improved in their own community. What are the problems? How can we work together to improve the quality of life? Where can we begin to take action? Awareness cam-

---

paigns, clean-ups, fund raisers to assist projects or to purchase resources for the classroom, school or community, acknowledgment awards to be given by the students to people in the community that they admire, action

committees and much more. (Some of the activities outlined in the Rancheria Redwood simulation may be useful in exploring these ideas.)

---

## References

- Bullard, Robert D.** 1993. *Confronting environmental racism: voices from the grassroots*. South End Press. Boston, Massachusetts. 259 pp.
- Churchill, Ward.** 1994. *Indians Are Us? Culture and genocide in Native North America*. Common Courage Press. Monroe, Maine 04951. 382 pp.
- Drinnon, Richard.** 1990. *Facing West: The metaphysics of Indian-hating and empire-building*. Schocken Books. New York, New York. 571 pp.
- Grover, Herbert J.** 1991. *A guide to curriculum planning in environmental education*. Wisconsin Department of Public Instruction. 125 South Webster Street. P. O. Box 7841. Madison, WI 53707-7841. 103 pp.
- Johansen, Bruce E.** 1982. *Forgotten founders: how the American Indian helped shape democracy*. Harvard Common Press. Harvard, Massachusetts. 167 pp.
- Lopez, Barry.** 1992. *The rediscovery of North America*. Vintage Books. New York, New York. 58 pp.
- Nabokov, Peter** (ed.). 1992. *Native American testimony*. Penguin Books. New York, New York. 474 pp.
- Ortiz, Simon J.** 1977. *The People shall continue*. Children's Book Press. Emeryville, California.
- Parsons, William S.** and Samuel Totten. 1993. *Guidelines for teaching about the Holocaust*. United States Holocaust Memorial Museum. 100 Rauol Wallenberg Place, SW. Washington, DC 20024.
- Slapin, Beverly and D. Seale** (eds.). 1992. *Through Indian eyes: the Native experience in books for children*. New Society Publishers. Philadelphia, PA. 312 pp.
- Weatherford, Jack.** 1991. *Native roots: how the Indians enriched America*. Ballantine Press. New York, New York. 310 pp.



---

# GLOSSARY

**Absorption:** a process in which one material takes up and retains another with the formation of a homogeneous mixture having the attributes of a solution.

**Acetone:** a solvent and thinner for paint, varnish, and lacquer, also used to clean and dry parts of precision equipment. Very flammable and volatile liquid. Explosive. Moderately toxic if inhaled.

**Acid:** any compound that can react with a base to form a salt; capable of turning litmus indicators red; releases a hydrogen ion in solution; has a sour taste.

**Acid rain:** rain with a high concentration of acids produced by the combination of water and sulfur dioxide or nitrogen oxide; emitted during the combustion of fossil fuels; it has a destructive effect on plant and aquatic life, buildings, etc.

**Adaptation:** a characteristic that improves an organism's chance for survival in a particular habitat.

**Aerobic:** decomposition of organic wastes occurring in the absence of oxygen, making possible conversion of material to compost.

**Aerate:** to supply or mix with air.

**Alkaline:** describes a chemical that is basic (e.g. soda or potash).

**Alloy:** a homogeneous mixture of two or more metals.

**Anaerobic decomposition:** decomposition of organic wastes occurring in the absence of oxygen, by bacteria which breathe an inorganic oxidant. Causes production and release of methane gas.

**Aquifer:** an underground bed of earth, gravel, or porous stone that contains water.

**Artesian water:** underground water trapped under pressure in a porous layer between non-porous rock layers.

**Artesian well:** a well bored into an artesian aquifer in which the water rises above the top of the water-bearing bed.

**Ash:** matter that remains after something burns.

**Ash fill:** a specially constructed landfill to be used only for disposing of ash.

**Base:** a chemical which forms a salt when it reacts with an acid; releases a hydroxide ion in solutions; turns litmus indicators blue; has a bitter taste.

**Bauxite:** a clay like ore from which most aluminum is made.

**Benzene:** a solvent widely used in chemical processes.

**Bioaccumulation:** the process in which certain substances, like pesticides or heavy metals, work their way into a river or lake, move up the food chain, and are eaten by aquatic organisms, which in turn are eaten by birds, mammals, or humans.



---

**Biodegradable:** the property of a substance that allows it to be broken down by microorganisms into simple stable compounds such as carbon dioxide and water.

**BTU:** British Thermal Unit. A measurement of heat: the amount of heat needed to raise the temperature of one pound of water 1 degree Fahrenheit.

**Calorie:** the amount of heat energy needed to raise the temperature of one gram of water by 1 degree Centigrade at standard atmospheric pressure.

**Capillary attraction:** the attractive force between two unlike molecules that causes a liquid to rise.

**Carcinogen:** substances that cause cancer.

**Caustic:** capable of corroding, burning, dissolving, or otherwise eating away by chemical action.

**Chemical energy:** a form of energy stored in the structure of atoms and molecules which can be released by a chemical reaction.

**Chlorinated hydrocarbons:** synthetic organic chemicals that contain hydrogen, carbon, and chlorine. Example: DDT.

**Composting:** the natural conversion of most organic materials to humus by microorganism activity, and an effective solid waste management technique for reducing the organic portion of waste.

**Condensation:** the process of water changing from a gas (water vapor) to a liquid.

**Corrugated cardboard:** heavy paper board, molded into parallel ridges and grooves (called liner board and medium).

**Corrode:** to eat into or wear away gradually, as by resting, or by the action of chemicals.

**Corrosive:** a chemical agent that reacts with or attacks the surface of a material causing it to deteriorate or wear away.

**Cullet:** scrap glass, usually ground and/or crushed into small uniform pieces. 1. Waste or broken glass, usually suitable as an addition to raw batch. 2. Foreign cullet-cullet from an outside source. 3. Domestic cullet (factory cullet) from within the plant. 4. Mixed cullet-scrap glass which is not separated by color.

**Cubic foot:** a volume unit used in measuring gas consumption.

**Cycle:** to circle, return, or occur again.

**Decompose:** to decay, rot, come apart, change form, break down into simpler components.

**DDT:** dichlorodiphenyl trichloroethane. A colorless, odorless chlorinated hydrocarbon insecticide which concentrates in food chains and kills organisms directly or indirectly (e.g., causes bird egg shells to be too thin to withstand the weight of incubation).

**Dioxin:** a commonly used name for the tetra chloro form of a family of compounds. Tests on laboratory animals indicate them to be among the most toxic man-made chemicals known.

**Disposable:** designed to be thrown away after use.

**Detoxify:** to neutralize poisonous material.

**Ecology:** the interrelationships between organisms and their environment.



---

**Ecosystem:** a system made up of a community of animals, plants, and bacteria and the physical and chemical environment with which it is interrelated.

**Energy:** the capacity to perform work or produce a change from existing conditions.

**Energy recovery:** the recovery of energy in a usable form from mass burning or refuse-derived fuel incineration, pyrolysis, or any other means of using heat of combustion of waste.

**Environment:** the complex of factors and conditions which act upon an organism or ecological community and ultimately determine its form and survival.

**EPA:** Environmental Protection Agency. A federal agency responsible for overseeing the protection of the environment.

**Environmental impact report:** a written analysis of a project's effect on the environment.

**Enzyme:** any of numerous complex proteins that are produced by living cells and bring about a chemical reaction specifically biochemical reactions at body temperature.

**Eutrophication** (also cultural eutrophication): over nourishment of aquatic ecosystem with plant nutrients. A natural process except when resulting from human activities such as agriculture, urbanization, and industrial discharge.

**Evaporation:** the process of water changing from a liquid to a gas.

**Ferrous metals:** iron and alloys containing iron, generally magnetic.

**Fiberglass:** small pieces of glass that are made into fibers. The fibers are used in insulation and can be molded with a plastic.

**Flammable:** easily started on fire, capable of burning rapidly.

**Fossil fuel:** naturally-occurring nonrenewable hydrocarbons such as coal, crude oil, or natural gas.

**Fly ash:** noncombustible residual particles from the combustion process, carried by smoke and air.

**Food chain:** the passage of energy from the sun in the form of food from producers through a succession of plant-eating and meat-eating consumers.

**Food pyramid:** an arrangement of community populations according to the number of organisms found in the food chain; shape of the "pyramid" is based on amount of energy available to each level.

**Food web:** a system of interlocking food chains.

**Generator:** a device which produces electric energy from mechanical energy. Also, a person responsible for producing waste material.

**Gross National Product (GNP):** the total market value of all the goods and services produced by a nation during a specific period.

**Ground water:** water that sinks into the soil, where it may be stored for long periods of time in slowly flowing and slowly renewed underground reservoirs called aquifers.

**Habitat:** the region where a plant or animal naturally lives; must include food, water, shelter, and space suitable to the animal's needs.

**Hazardous waste:** a substance which can cause serious illness or death or which may substantially threaten human health or the environment when it is not properly controlled.



**Herbicide:** a chemical used to kill plants; a kind of pesticide.

**Hydrocarbon:** a chemical compound composed solely of carbon and hydrogen; usually derived from living material.

**Hydrologic cycle:** the complete cycle where water passes from the oceans through the atmosphere, to the land, and back to the ocean.

**Hydrosphere:** the surface water that covers the earth.

**Impermeable:** not permitting water or another fluid to pass through.

**Incineration:** to cause to burn to ashes; burning in a furnace.

**Ingot:** the block of a pure metal such as aluminum.

**Inorganic:** matter that has never been living.

**Invertebrate:** a simpler form of animals having no backbone.

**Kinetic energy:** the energy of motion; the ability of an object to do work because of its motion; usable energy.

**Landfill:** a large, outdoor area for waste disposal. Landfills where waste is exposed to the atmosphere are called open dumps; in sanitary landfills, waste is layered and covered with soil.

**Leach:** to remove or be removed from, by the action of a percolating liquid.

**Leachate:** material that is filtered or leached from the soil. Often contains hazardous substances.

**Leaching:** the process in which various soil components (such as salts and metals) found in upper layers are dissolved and carried to lower layers and in some cases to groundwater.

**Litter:** waste materials carelessly discarded in an inappropriate place. Litter is waste out of place.

**Materials recovery:** manual and/or mechanical separation of recyclables or compostables from mixed solid waste.

**Mechanical energy:** one form of energy. It is observable as the motion of an object.

**Methane:** a colorless, odorless, flammable gaseous hydrocarbon present in natural gas and formed by the decomposition of living matter. Can be used as fuel.

**Mixed paper:** waste paper of various kinds and quality, including manila folders and colored copier paper, construction paper, and newspaper.

**Native species:** an indigenous plant or animal.

**Nitric acid:** a colorless, fuming acid that is highly corrosive, a contributor to acid rain.

**Nitrogen cycle:** the continuous cyclic progression of chemical reactions in which atmospheric and other nitrogen sources are compounded, dissolved in precipitation, deposited in soil, assimilated and metabolized by bacterial and plants, consumed by animals, and returned to the atmosphere by organic decomposition.

**Nonferrous metals:** metals and alloys which contain no iron, such as aluminum, copper, brass, and their alloys.



---

**Non-renewable resource:** a resource that cannot be recycled naturally into its original form, i.e., iron, oil, metal ore.

**Open dump:** an open disposal site. In the United States, open dumps have been replaced by landfills.

**Ore:** mineral or combination of minerals from which metals or other valuable substances can be mined.

**Organic:** derived from living organisms. Also, designating any chemical compound containing carbon.

**Organism:** anything that is alive.

**Packaging:** a commodity's wrapping or sealing. Any protective covering for products which is not a useful part of the product itself.

**Packaging materials:** any of a variety of papers, cardboards, metals, wood, paper board and plastics used in the manufacture of containers for food, household, commercial and industrial products.

**Paper:** in a general sense, the name of all kinds of matted or felt sheets of fiber formed on a fine screen from a water suspension. More specifically, paper is one of two broad subdivisions (the other being paper board) of the general term paper. Paper is usually lighter in basis weight, thinner and more flexible than paper board, is used largely for printing, writing, wrapping and sanitary purposes.

**Paper board:** a heavy paper product used to make cereal boxes, snack boxes, etc. It is commonly also called cardboard. It is frequently made of recycled paper.

**Percolation:** downward flow or infiltration of water through the pores or spaces of rock or soil.

**Photosynthesis:** the process by which green plants convert sunlight and minerals contained in the soil and carbon dioxide in the air into oxygen that we breathe and food for the plant.

**Pitch:** a thick, dark, sticky substance found in coal, wood, and petroleum. It is used to line the pots in which aluminum is made.

**Plastics:** man-made materials consisting of large molecules called "POLYMERS" containing primarily carbon and hydrogen with lesser amount of oxygen or nitrogen, frequently compounded with various organic and inorganic compounds as stabilizers, colorants, fillers and other ingredients.

**Plastic foam:** light-weight products manufactured by causing plastic to foam during the forming process. Examples include the foam "peanuts" used in packing items in boxes, and foam trays and boxes used in fast food service.

**Pollution:** harmful substances deposited in the air, water or on land, leading to a state of dirtiness, impurity, or unhealthiness.

**Post consumer material:** any product that has been used by someone; it has served its initial purpose.

**Precious metals:** rare and costly metals such as silver, gold, and platinum.

**Precipitation:** a weather term meaning the deposit or fall, of rain, sleet, or snow.

**Polystyrene (PS):** a durable plastic composed of hydrogen and carbon atoms made from a by-product of the petroleum and natural gas distillation process. A "Styrofoam" coffee cup is an example of PS.



---

**Reclamation:** the restoration to usefulness or productive of materials found in the waste stream. These reclaimed materials may be used for purposes which are different from their original use.

**Recyclables:** almost all natural and some man-made materials, most commonly glass, aluminum, newspaper, cardboard, tin, plastic, and oil.

**Recycle:** the collection and reprocessing of manufactured materials for reuse either in the same form or as part of a different product.

**Recycling center:** a site where manufactured materials are collected and resold for reprocessing. Types of recycling centers are: "Buy back--a center where the recycler pays for materials. Donation--a center where the recyclers accepts donated materials. Drop-off--an unattended donation station

**Renewable resource:** a naturally occurring raw material or form of energy derived from an endless or cyclical source, such as the sun, wind, falling water (hydroelectric), biofuels, fish, and trees. With proper management and wise use, the consumption of these resources can be approximately equal to replacement by natural or human-assisted systems.

**Residual waste:** waste materials generated in houses and apartments. The materials include paper, cardboard, beverage and food wastes, glass containers, old clothes, garden wastes, etc.

**Resin:** a natural, organic substance used to manufacture varnish, ink, and plastic.

**Resource recovery:** a term describing the extraction and utilization of materials and values from the waste stream either as materials which can be used as "raw materials" in the manufacture of new products which can be converted into forms of fuel or energy source.

**Reuse:** to extend the life of an item by repairing or modifying it, or by creating new uses for it.

**Sanitary landfill:** a site for the burial and decomposition of solid waste. A specially engineered site for disposing of solid waste on land constructed so that it will reduce hazards to public health and safety. Sanitary landfills designed to Federal Resource Conservation and Recovery Act standards require, among other things, an impermeable lower liner to block the movement of leachate into ground water, a leachate collection system, gravel layers preventing the control of methane, and daily covering of garbage with soil.

**Sewage:** liquid or solid waste which is carried off by sewers and purified in a sewage treatment plant.

**Soda ash:** a white material made from the mineral called Sodium. Soda ash is used to make glass.

**Soil:** the upper layer of earth, improperly called dirt.

**Solid waste:** all solid and semi-solid wastes, including garbage, rubbish, ashes, industrial wastes, demolition and construction wastes, and household discards such as appliances, furniture, and equipment.

**Solid waste management:** the controlling, handling, and disposal of all refuse. The goal of this solid waste management curriculum is to reduce waste to a minimum through the "3R's" of reduction: reduce, reuse, recycle.

**Source separation:** the sorting out of recyclable materials at home, in schools, and businesses.



---

**Tipping fee:** the price individuals, communities, and trash hauling companies must pay at a disposal site to get rid of their trash or the trash they collect. The fee is called a tipping fee because truck drivers must unload by tipping up the back of the truck.

**Topsoil:** the top layer of soil containing valuable nutrients.

**Transfer station:** an intermediate collection facility temporarily holding solid waste en route to the landfill or incinerator.

**Transpiration:** the release of water vapor through tiny pores in the leaves of plants.

**Virgin materials:** any basic materials for industrial processes which have not previously been used (B.g. trees, iron ore, silica sand, crude oil, bauxite.)

**Wastepaper:** paper that has been discarded. This paper can be used again as a recyclable materials, if the grade of paper is acceptable and if the paper is separated before it enters the waste stream.

**Waste reduction:** preventing and/or decreasing the amount of waste at its source by changing societal patterns of design, production or consumption.

**Waste stream:** a general term used to denote the waste material output of an area, location or facility.

**Waste-to-energy:** a process where energy, in the form of steam or electricity, is produced by burning solid waste.

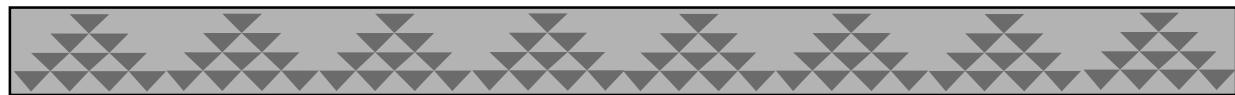
**Watershed:** an area from which water drains and contributes flow to a given place, or point, on a stream or river.

**Water table:** the level underground below which the soil or rock is saturated with water, sometimes referred to as the upper surface of the saturated zone.

**Wood fiber:** a stringy substance made from wood. This substance makes paper feel the way it does (this is called texture). It also helps keep together the ingredients that make paper.

**Wood pulp:** when wood fibers are combined, they are called pulp. The pulp is used to make paper and paper board.

**Yard wastes:** leaves, grass clippings, pruning, and other organic discarded materials collected from lawns. Yard waste is used for compost materials.



---

# RESOURCES

*A-Way With Waste*, Washington State Department of Ecology, 300 Desmond Dr. S.E., P.O. Box 47600, Olympia, Washington 98504-7600.

*AVR Teacher's Resource Guide*, Association of Vermont Recyclers, POB 1244, Montpelier, Vermont 05601.

*Closing the Loop*, California Integrated Waste Management Board, 8800 Cal Center Drive, Sacramento, California 95826.

*Exploring the Coastal Environment and its Resources*, Science and Mathematics Education, School of Natural Sciences, California State University, Long Beach, California 90813.

*Keepers of the Earth: Native American Stories and Environmental Activities for Children*, by Michael J. Caduto and Joseph Bruchac, Fulcrum, Inc., Golden, Colorado.

*Project WILD*, Western Regional Environmental Education Council, POB 18060, Boulder, Colorado 80308-8060.

*Super Saver Investigators*, Ohio Department of Natural Resources, Division of Litter Prevention and Recycling, Educational Specialists: SSI, Fountain Square, Building F-2, Columbus, Ohio 43224.

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

*The California Class Project*, California Department of Education, 721 Capitol Mall: POB 944272, Sacramento, California 94244-2720.

*The Green Box*, Humboldt County Office of Education, 901 Myrtle Avenue, Eureka, California 95501.

*The No Waste Anthology*, California Department of Toxic Substances Control, POB 942732, Sacramento, California 94234-7320.

*Toxics in My Home? You Bet!*, Golden Empire Health Planning Center, c/o Local Government Commission, 909 12th Street, Suite 305, Sacramento, California 95814.

*Waste Away*, Vermont Institute of Natural Science, POB 86, Woodstock, Vermont 05091.

*Water Pollution Clean Up*, Hudson River Sloop Clearwater, 112 Market Street, Poughkeepsie, New York 12601.



# *Art Acknowledgements*

## *Photos contributed by:*

*Alan Lefridge*

*Jill Fletcher*

*Jennifer George*

## *Borders designed by:*

*Linda McRae*

*Derek Gamlyn*

*Doug Laursen*

## *Illustrations by:*

*Lyn Risling*

*Doug Laursen*

*Derek Gamlyn*

## *Cover designed by:*

*Derek Gamlyn*

