DOCUMENT RESUME

ED 098 070	88	SE 018 235

AUTHOR	Giebelhausen, Maribeth R.; And Others
TITLE	Trash--Our Only Growing Resource. Environmental Ecological Education Project.
INSTITUTION	Missouri State Dept. of Education, Jefferson City.; Parkway School District, Chesterfield, Mo.
SPONS AGENCY	Bureau of Elementary and Secondary Education (DHEW/OE), Washington, D.C.
PUB DATE	[73]
NOTE	110p.
EDRS PRICE	MF-$0.75 HC-$5.40 PLUS POSTAGE
DESCRIPTORS	Conservation Education; Curriculum Guides; Ecology; *Environmental Education; Instructional Materials; Learning Activities; Natural Resources; *Recycling; *Secondary School Science; Teaching Guides; *Waste Disposal; *Wastes
IDENTIFIERS	Elementary Secondary Education Act Title III; ESEA Title III

ABSTRACT

With the increases in population and technology, non-biodegradable materials like plastic, glass, and aluminum and waste disposal have become very real problems in out society. This unit, designed for seventh-grade students, focuses on the problems of waste disposal and examines the function of recycling, the role of the consumer in determining types of packaging materials, facts about biodegradable and non-biodegradable materials, and the economic reasons for utilizing synthetic materials. The unit includes the behavioral objectives and the expected student criteria for evaluation, pretests and posttests, relevant background information, suggested methodologies and time sequences for the activities, a bibliography of available reading materials, films and local resource people, and a glossary of terms and environmental resource inventories for each of the junior high schools in the Parkway School District, Chesterfield, Missouri. (MLB)

ENVIRONMENTAL ECOLOGICAL EDUCATION PROJECT

Parkway School District
Chesterfield, Missouri

DR. WAYNE FICK, Superintendent
VERLIN M. ABBOTT, Project Director

UNIT: Trash - Our Only Growing Resource

The work presented or reported herein was performed pursuant to a Title III ESEA Grant administered by the Missouri State Department of Education

TRASH -- OUR ONLY GROWING RESOURCE

Maribeth R. Giebelhausen
Richard Snodgrass
Gary Zide

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

SETTING

Everyone's at fault; including you! You are a part of a tremendous problem which is of course, our problem of waste disposal. The U.S.A. is the most wasteful nation on the earth. Every American throws out a ton of waste every year.

Long ago, humans had no problem in disposing of waste. Bones, skins, and even wooden tools would eventually decay or be broken down by bacteria. But along with man's technology have come such materials as plastic, glass, synthetic rubber, and aluminum, that may last a century or more. Imagine your great grandchildren walking along the beach in the twenty-first century and stepping on a tab top from an aluminum soda can that you threw away just yesterday!

Today we are putting our technology to work in solving the problems of waste disposal. Recycling of non-biodegradable materials is becoming a science in itself. One good example is glasphalt. This is a new road material that is a combination of glass (crushed) plus asphalt. Another is the discovery of new microbes that speed up the decomposition of materials once thought to be non-biodegradable. You, too, as an individual can help solve the problem of wasting our resources. This unit's purpose is to explore the various avenues that the individual can take to aid the community in overcoming the waste disposal problem.

Note to Teacher

The unit is designed so that for each concept, the behavioral objective, the teacher background and the activities follow. In this manner all information necessary to teach a particular concept is together. It is advised that the teacher follow the sequence given.

The pre-test is to be given the first day of the unit. You are to grade and possibly record results for your own benefit, but do not return the test to the students. This test will help you realize how much the students know on the subject of recycling. Following the unit on recycling, give the students the post-test which is the same test as the pre-test. We feel that you should not use the pre or post-test as the means for the grade. We would rather see you give your grade on the basis of the activities that the students do in the instructional sequence for the unit. After the post-test, fill in the student evaluation sheet for the unit.

Additional Ideas and Activities

Possible activities and resources that may be used will be found at the end of this unit on pages entitled Environmental Resource Inventory. These inventory pages are arranged according to school sites, however, you will find that an idea or activity may apply to your building as well.

CONCEPTS

I. Recycling occurs in nature independent of man.

II. The function of recycling is to help preserve our environment by reusing our resources.

III. Man assumes his role as an integral part of the environment when he returns natural materials and synthetic materials to be reused.

IV. Substances which are attacked by living organisms are biodegradable because they can be decomposed.

V. Plastics and other synthetic materials are non-biodegradable because they cannot be decomposed by living organisms.

VI. Man copies nature by composting certain biodegradable materials.

VII. Materials which are non-biodegradable can be made useful by man's technology.

VIII. The consumer is a major determiner of the types of materials used in packaging.

IX. Synthetic materials (non-biodegradable) are often used in packaging for economic reasons.

BEHAVIORAL OBJECTIVES

Concept Number		
I.	1.	85% of the students will be able to state, in not more than two sentences, one method in which recycling occurs in nature independent of man.
II.	2.	75% of the students will be able to correctly complete the following: The function of recycling is ______.
III.	3.	50% of the students will be able to explain in a paragraph of 50 words or less how man is an integral part of the environment when he returns natural materials and synthetic materials to be reused.
IV.	4.	85% of the students will correctly fill in the blank: Substances which are attacked by living organisms and decompose are said to be ________.
V.	5.	85% of the students will select the correct term from a list of four possible terms for a material that cannot be decomposed by living organisms.
VI.	6.	70% of the students will be able to explain in a paragraph of 40 words or less how man copies nature by composting certain biodegradable materials.
VII.	7.	65% of the students will be able to explain how two non-biodegradable materials can be made useful through man's technology.
VIII.	8.	60% of the students will choose one product from a list of five like products and explain in a list of three reasons why the majority of students in the class would purchase that product.
IX.	9.	70% of the students will be able to choose the least expensive item from each of three pairs of items based on packaging materials used.
X.	10.	95% of the students will be able to name two jobs related to recycling for each of the following three areas: A. Skilled B. Semi-skilled C. Unskilled

Behavioral Objective Number

PRE-POST TEST

1.   1. State in not more than 2 sentences 1 method of recycling which occurs in nature independent of man.

2.   2. The function of recycling is ______________________.

3.   3. Explain in a paragraph of 50 words or less how man is an integral part of the environment when he returns natural and synthetic materials to be reused.

4.   4. Substances which are attacked by living organisms and are decomposed are said to be ______________________.

5.   5. From the list below, select the correct term for a material that cannot be decomposed by living organisms.

   A. Returnable

   B. Recyclable

   C. Non-Biodegradeable

   D. Depleteable

6.   6. Explain in a paragraph of 40 words or less how man copies nature by composting certain biodegradeable material.

7.   7. Explain how two non-biodegradeable materials can be made useful through man's technology.

   A.

   B.

Behavioral Objective Number | Pre-Post Test (cont.)

8. 8. Given a product such as spinach, that can be placed in at least five different containers, choose one from the list below and give three reasons why the majority of the students in the class would purchase the product in that container.

Circle your choice:

A. Tin Cans

B. Glass Jar

C. Paper Box (Frozen) covered with plastic

D. Frozen in a plastic bag

E. Packed fresh in a combination of styrofoam and plastic.

Reason:

1.

2.

3.

9. 9. Circle the least expensive type of container that milk, potato chips, and glass cleaner are packaged in. Base your answer on the packaging material used.

A. Milk--Glass . . . . Plastic
B. Potato Chips--Paper can . . . . Plastic bag
C. Glass cleaner--Plastic bottle . . . Aerosal can

10. 10. Name two jobs related to recycling for each of the three areas listed below.

A. Skilled

B. Semi-skilled

C. Unskilled

ANSWERS TO PRE-POST TEST

1. One possible answer:
   A decaying log is an example of natural recycling because all of its elements will return to the soil to be reused.

2. The function of recycling is to preserve our environment by reusing our resources.

3. Man is an integral part of the environment when he recycles materials because he is assuming his natural role. By this I mean that he understands the workings of nature and also attempts to copy nature. He realizes that man cannot keep taking from nature without returning the elements back.

4. Biodegradeable

5. C. non-biodegradeable

6. In nature organic materials decay and return to the soil. When man composts he put all biodegradeable materials in a pile and the material decays. This is the natural scheme of things.

7. Glass can be ground up and used in asphalt highways and cans can be melted down and made into new cans.

8. In answering this question the students should show an awareness of the aesthetics, ecological soundness of the packaging, appropriate packaging and advertising.

9. a. plastic

   b. plastic bag

   c. plastic bottle

10. a. Skilled -- microbiologist, chemist, engineer, market researcher

    b. Semi-skilled--lab technician, landfill operator

    c. Unskilled--garbage collector, truck driver

Outline of INSTRUCTIONAL SEQUENCE

BEST COPY AVAILABLE

Give Pre-Test

Week	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
1	B.O.1 Discussion Recycling in Nature--Activity: Locate evidence for recycling in nature. (out of doors)	B.O.1 Return to outdoors evidence and note living organisms which help the process along.	B.O.2 Activity: How much garbage do you produce?	B.O.2 Activity: Garbage in the school.	B.O.2 Work on activities--complete at home.
2	B.O.2 Activity-Small group Introduce possible topics-students choose topic and begin planning.	B.O.2 Work on small group activity.	B.O.2 Discuss how recycling helps preserve our environment and why recycling wasn't a problem in the past.	B.O.3 Activity: Survey for recycling or a project for recycling.	B.O.3 Small group activity do work on survey or project on recycling.
3	B.O.3 Work on survey or project. Discuss how man assumes his role as an integral part of his environment when he returns natural and synthetic materials to be reused.	B.O.4 and 5 Activity: Miniature Landfill.	B.O.4 and 5 Activity: Biodegradability.	B.O.4 and 5 Discussion: Biodegradability.	B.O.6 Plan a compost pile: Select group to build it: Have students begin to bring in necessary materials.
4	B.O.6 One group works on building the compost. Two readings on history of composting.	B.O.6 Discuss readings and compare natural decay with composting.	B.O.7 INDIVIDUAL ACTIVITY Take non-biodegradable containers and turn into piece of art or some useful object.	B.O.7 Assign groups and topics for reports. Continue activity and have it finished at home.	B.O.7 Possible field trips to landfill or speaker from asphalt company that mixes synthetic rubber with asphalt or glasphalt.
5	B.O.8 Students bring in one recyclable and one non-recyclable package. Discuss characteristics that make it good or bad.	B.O.8 Working in groups, student analyze packaging. 1. Aesthetics 2. Ecologically sound 3. Appropriate package 4. Advertising (psychology)	B.O.8 Discuss previous days work. Discuss future assignment to design a package.	B.O.8 Speaker on packaging materials. Ken Heim, Home Office 423-8186 Plant Office PE1-1200 REXHAM COMPANY	B.O.8 Activity: Begin designing container including commercial to sell product.
6	B.O.8 Continue activity.	B.O.8 Display and perform commercial.	B.O.9 Field trip to grocery to compare packaging materials and price.	B.O.9 Discuss economics of packaging.	B.O.10 Discuss careers related to recycling.

Give Post-Test

CONCEPT I Recycling occurs in nature independent of man.

BEHAVIORAL OBJECTIVE #1 85 per cent of the students will be able to state in not more than two sentences one method that recycling occurs in nature independent of man.

Teacher Background

Recycling is a man made term for something that has been going on in nature ever since the earth was formed. Before man developed his technology there was no problem of putting natural resources into the earth. Simple ecological systems such as -- producer, consumer, decomposer -- kept the elements of the earth in a state of balance. Each living organism held a vital role in nature. From tiny microbes which aided in decomposition of living matter, to huge carnivorous animals, elements necessary to sustain life are returned to the land.

The evolution of the human species has altered nature's way of reusing the elements the earth has given us. How did man in the past play a role in the sequence of nature? He was both stalker of meat, and like-wise was stalked. When he died there were no caskets or vaults to prevent microbes from returning the elements in his body back to the earth. He had no synthetic materials that would not break down into their natural state.

Man's relationship to nature is changing. There is an increasing awareness that without a plan to balance nature's way with man's technology, this may result in great environment problems.

To locate in nature areas where recycling is occurring is not a difficult task. Simple outside activities such as observing an old log that is dead and rotting can be very helpful. Or finding an animal that has died and is in different states of decomposition, may be very interesting when showing how nature reuses her resources. There are many types of communities that are associated with decomposition (e.g. maggots) that should be pointed out in the discussion.

There are certain elements that easily show the different phases they go through, two of which will be explained below.

1. The Carbon Cycle

   A. Step one: Present in the soil and air.

   B. Step two: Taken in by plants and changed into carbohydrates in the form of either sugars or starches. (producer)

   C. Step three: Animals eat the plants, use the carbohydrates. (consumer)

   D. *Step four: Animal or plant dies and returns carbon to the soil. (decomposition)

If students have trouble understanding Step four, explain how coal is formed from the remains of millions of plants (mainly ferns) that have decomposed and with the help of great pressure have gone back to their natural element -- carbon.

2. The Nitrogen Cycle

   A. Step one: Nitrogen is present in soil and air.

   B. Step two: Taken in through the roots of plants from the soil.

   C. Step three: Eaten by animals -- changed to usable form called amino acid to be used by the body.

   D. Step four: Animals and plants die -- aided in decomposition by bacteria -- and return nitrogen to the soil or air.

ACTIVITY CONCEPT I

This concept must be demonstrated in an outdoor activity -- either going outside the school or a field trip to the "98 Acres." (Contact EEE Staff) <u>The assignment is to find evidence of change having taken place.</u> After giving the assignment (see data sheet), even though the students may be unclear at this point take them outside. The students might ask questions as, "What do you mean by change?" You as the teacher should throw the question back to the class to come up with an operational definition of change. Next focus each student on evidence for kinds of changes and let him make observations. The students should fill in data sheet. Let the students spend one-half period outside. After the excursion, return to the classroom. The students should relate their evidences for change and these should be recorded on the blackboard. Some of the changes may be: cloud formations change, example of erosion, mortar from bricks eroding on the building, etc.

The second part of the activity is focusing on the topic of recycling in nature. Hopefully at this point the students realize that change is always occurring and that in nature there is a never ending process of change. The students should return to the outdoors to examine recycling in nature. Recycling in this concept refers to the natural resources being used over and over again as in the cycling of elements in the natural ecosystem. For example, a decaying log illustrates the return or recycling of the elements of carbon, nitrogen, etc. back into the soil. <u>The assignment is to find two evidences for recycling in nature surrounding the school or the "98 Acres."</u> Following this activity a list of examples of natural recycling should be compiled. A discussion of these should follow. The major point of this discussion is that recycling is a natural process; it occurs without the help of man; natural recycling should show man how to deal with his discarded materials.

Data Sheet 1

Name ____________________

Date ____________________

1st. Day:

1. What is your definition of change?

2. List 2 evidences of change having taken place. Describe this change.

3. Why did these things change?

2nd Day:

1. Is change inevitable?

2. Is nature constantly changing?

3. Define recycling -- include how recycling involves change.

4. Find 2 evidences for recycling in nature. Describe this recycling.

5. Find some living organisms or evidence of living organisms that help the recycling process.

CONCEPT II The function of recycling is to help preserve our environment by reusing our resources.

BEHAVIORAL OBJECTIVE #2 Seventy-five per cent of the students will be able to correctly complete the following: The function of recycling is ________________.

Teacher Background

Waste disposal in the home can be classified into two types: (1) Garbage - all materials that result from food waste, including both animal and vegetable waste, and (2) Trash - which includes primarily paper waste, and also metal containers, glass, plastic and other synthetic materials.

There are many ways to dispose of waste materials. Almost ninety per cent of all solid waste is either incinerated or buried in a landfill. But both of these have difficult problems associated with them. For example, with the increasing amount of air pollution, incinerators have been banned from public use. Parkway South Junior High was built in 1964 and the incinerator there was used for only one year before being put out of commission.

The problem with landfill areas is becoming quite evident. Land is a precious commodity, and to tie up millions of acres of land in which to dump our trash is purely impractical. Besides over half of all material put into a landfill is non-biodegradable and as the land and soil settles in the area, eventually the glass and plastics work theirselves to the top.

Garbage can be taken care of by still another means. Composting is being utilized in many European countries to help alleviate the solid waste disposal problem. But here in the United States this method has not yet caught on. More on composting will be discussed under Concept VI.

Another method by which to dispose of solid waste materials is called a Pneumatic-tube disposal system. Sundbyber, Sweden already has one that is functioning, and a similar plan is being implemented by an apartment complex in New Jersey. This system involves first the house holder who dumps all of his trash down a tube where it is mechanically separated. For example, paper goes to a paper mill, glass is turned over to a glass container manufacturer to make new bottles and jars. Aluminum travels to a smelter, scrap iron and steel to a foundry. Food scraps are mixed with sludge and agricultural waste to make compost fertilizer.

Still another avenue which can be taken is the development of new bacteria which are able to break down many of the synthetic materials that we now use. For example, Dr. Walter Nickerson is searching for organisms that will break down plastic. He has already discovered two different organisms that speed the decay of rubber tires.

In this concept the teacher must emphasize the fact that there are many means by which to dispose of our solid waste. But none of these are economically feasible unless some consideration is given to the recycling of materials in the home. By returning glass, paper, etc. to recycling centers the student is imitating a solution to the solid waste disposal problem.

There are three major reasons as to why recycling should be considered: 1) resource depletion, 2) solid waste problem, 3) littered condition of our environment. The question whether recycling will be found to be a satisfactory method is affected not only by current (short-term future) recycling technology, but also by current economic and legal structure.

View 1. That of economist: They argue that technology is the answer to the gradual decline in quality and quantity of the resource base. They point out that money spent on raw materials has fallen and is continuing to fall today. Hence they conclude that resources are becoming more available today. Actually, in economic terms, resources are becoming cheaper. This is the result of man's technology finding better means of extracting the ore and more economical ways of substituting one set of goods for another.

View 2. That of physical scientist: They are more pessimistic, and argue that we can not indefinitely consume materials from a finite supply, disregarding a low rate of use. Some even feel that there is a limit to man's technology.

Here we have two viewpoints. One says, (that of the economist) let man's technology handle the problem. On the other hand, the scientists say our resources are becoming exhausted and technology is not necessarily the answer. Therefore, the solution is recycling by both the consumer and the manufacturer. Cut down on the materials (resources) that we put in a landfill or incinerator and lose forever. Also, recycle resources back into a usable form. Let's all recycle.

Recycling is the answer to the solid waste disposal problem. It will help to preserve our environment by reusing our resources. We won't have to strip the land as extensively for new mineral deposits, if we use those we already have. It will help prevent the excessive use of ugly landfills and incinerators which pollute. But recycling can only be accomplished by making the public aware of the problem.

The information on the following page was included to help define the problem of solid waste and litter.

THE PROBLEMS

LITTER

unsightly, undesirable, unnecessary.

Definition the stuff we throw away, in streets and alleys, roadsides and parks. Composition[1] paper, 59.5%, cans, 16.3%, glass, 5.9%, plastic, 5.8%, miscellaneous, 12.5%. (Beverage containers, cans and bottles, account for less than 20% of all litter.)

Litter is misplaced waste and trash. People cause litter through carelessness. People can eliminate litter through carefulness.

Litter is that part of the total waste problem we see, like the tip of an iceberg. The far bigger more formidable part of the problem is that part we don't see solid waste.

SOLID WASTE

inescapable, but manageable

Definition the stuff that makes it to the city dumps and junk yards. Composition clothing, automobiles, appliances, furniture containers everything we produce, use and discard. (Beverage containers account for only 3.9% of all solid waste.)

We pile up over 200 million tons of solid waste in this country every year. That's roughly a ton a person. Out of sight out of mind yes. Out of existence, no. Solid waste is a man-made problem, a by-product of living. And the richer the nation, the greater the amount of solid waste generated. This country spends four and one-half billion dollars every year for trash collection, not to mention waste disposal treatment. Depending on location it costs us from $14 to $30/ton to collect and dispose of urban solid waste. The problem won't go away, but it is manageable.

[1]**Source.** National Academy of Science – National Academy of Engineering Highway Research Board (1969). "A National Study of Roadside Litter." Summary available from Keep America Beautiful, Inc., 99 Park Ave. New York N.Y. 10016.

[2]**Source:** Environmental Quality the first annual report of the Council on Environmental Quality transmitted to the Congress August 1970 p. 117.

ADDITIONAL SOURCE REFERENCES: Pollution Facts. Common Sense Guides to Environmental Problems. Returnables vs non Returnables. Published by Community and Regional Development Group, Chamber of Commerce of the United States 1615 H St., N.W., Washington D.C. *and* National Center for Resource Recovery, Inc. Suite ... D.C.

SOLUTIONS

(to the litter problem).

1. Support legislation to ban tax, or require mandatory deposits on convenience packaging, such as cans and one-way bottles.

What happens? The problem remains unsolved. Over 80% of litter is untouched. Taxes on beer now generate up to 50 times the cost of disposing of beer packaging material. If penalties on convenience packaging caused just a 1.6% decrease in beer sales, the loss in tax revenue would exceed the total cost of properly disposing of all brewing industry packaging. Further, present experience with returnable bottles indicates that they too often become litter.

2. Establish fines for littering.

What happens? The effect of such legislation is unclear. In areas where laws against littering have been established, the amount of litter has not been significantly reduced. To date, the laws have been unenforceable, or unenforced. While such legislation seems to be constructive in theory, it is not an effective solution.

3. Join "Pitch-In," an anti-litter campaign that offers more than words.

What happens? You recognize the problem of litter as one of human behavior. You change your habits. You get personally involved in a program to eliminate litter through local community action. You work through a program backed by plans and materials to assist you at the grass roots level. If this approach appeals to you, contact your state U.S.B.A. representative, or write for full details. United States Brewers Association, 1750 K St., N.W., Washington, D.C. 20006.

SOLUTIONS

(to the solid waste problem)

1. Open dumping.

What happens? Valuable resources are lost. We scar our countryside with unsanitary eyesores. Land is too precious.

2. Incineration.

What happens? Valuable resources are lost. Most systems pollute our environment. Air is too precious.

3. Dumping in water.

What happens? Valuable resources are lost. We contaminate our rivers, lakes and oceans. Life is too precious.

4. Voluntary reclamation programs.

What happens? Valuable resources are recovered. Manufacturers cooperate with concerned consumers to reclaim used cans and bottles (often through cash payments). This approach encourages involvement, but in fact depends on voluntary labor. It is not at present economically feasible. And it doesn't solve the bigger problem of solid waste.

5. Technology.

What happens? Valuable resources are recycled. We use technology to get solid waste back into the economy. We rely on the same technology that accelerates the growth of solid waste to develop methods to control it. Unrealistic? Quite the contrary. Technology and free enterprise offer the only practical long-term answers to the problem of solid waste.

Three examples:

1. The Black-Clawson Solid Waste Recycling Plant established in 1969 in Franklin, Ohio, handles 150 tons of refuse daily. Refuse is fed into a hydrapulper, where it is mixed with water. Heavier solids are ground up and ejected through a conveyor. Further processing separates glass and ferrous and non-ferrous metals. Reclaimed fibers from slurry are dried for use in recycled paper. This plant is designed to take care of Franklin's solid waste tonnage through 1990.

2. The Combustion Power Company in Menlo Park, Calif., is building a scale pilot plant to consume 400 tons of refuse daily (the normal output of a community of 150,000 people). Solid waste is shredded, then separated by an air classifier. Heavier materials are removed for recycling, while lighter materials are fed into a fluid bed combuster. This combuster converts the energy value of these lighter materials into electricity for the community.

3. Sunset Scavenger Company of San Francisco, Calif., through private initiative and enterprise, processes all of that city's refuse through a modern transfer station. Solid waste is transported to a sanitary landfill operation outside Mountain View, Calif. Eventually this landfill will become a landscaped golf course and recreation center. The size and efficiency of this operation has led to the development of plans for installation of a metal and glass reclamation center at the transfer station. Technology will permit separation of light materials for use in landfill work.

From: "Litter and Solid Waste," a pamphlet from Anheuser-Busch, Inc.; St. Louis, Missouri 63118

Activities - Concept II

1. How much garbage and trash do you produce?

To make the necessity for recycling more meaningful in a personal manner, let's find out how much garbage and trash is discarded by the families of the students in our class (use tables on the following pages.)

Each student will need 4 large plastic bags (trash can liners). Each student will arrange to have his household garbage separated as materials are discarded. Garbage may be separated as follows:

Bag No. 1	--	Paper materials
Bag No. 2	--	Metal materials
Bag No. 3	--	Glass and ceramic items
Bag No. 4	--	Everything else

After a few days or a week the trash is weighed before being put out for collection. Data should be recorded in the charts following this sheet. In analyzing the data we must take into consideration the number of people in the family and the length of time materials were collected. We want to know the amount of materials discarded per person per day.

Example:

Family of 2 persons $\quad 2\overline{)16}$ garbage per person in 4 days

16 pounds of garbage

Collected in 4 days $\quad 4\overline{)8}$ garbage/person/day

Results: 2 pounds of garbage per person per day.

After calculating the amount of garbage per person per day in the proper chart we will break down the data into percentages of kinds of garbage.

20 pounds of paper

40 pounds of total garbage

$$\frac{(20 \text{ lbs.})\ (100)}{40 \text{ lbs.}} = 50\% \text{ paper}$$

After completing these calculations you can compare this information with the results of detailed scientific studies shown in Table 4.

Data Sheet 2

Table 1

me ____________________

Date ____________________

Total Amounts of Garbage Discarded by Students' Families for Different Periods of Time[1]

Student No.	No. of People in household	No. of days of collection	Pounds and Ounces				Total Weigh
			Paper	Metal	Glass ceramics	Other materials	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
Total							
Average							

1. From: Schatz, Albert and Vivian, Teaching Science with Garbage, page 46.

Table 2 Data Sheet 2a

Average Amounts of
Garbage Discarded Per Person/Per Day[1]

Name______________________

Date______________________

Student No.	Paper	Metal	Ounces of Glass and Ceramics	Other Materials	Total Weight
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
Total					
Average					

1. op. cit. page 47.

Name________________________

Date________________________

Data Sheet 2b

Table 3
Percent Composition of Garbage
Calculated from Average Amounts
in Table 2[1]

Garbage	Average Weight	Percent composition by weight
Paper		
Metal		
Glass and Ceramics		
Other materials		
Total		100

Table 4
Average Percent Composition by Weight of
Household Garbage from 21 U.S. Cities*[2]

Component	Percent by weight
Food Waste	18.2
Garden waste	7.9
Paper Products	43.8
Metals	9.1
Glass and ceramics	9.0
Plastics, rubber, and leather	3.0
Textiles	2.7
Wood	2.5
Rock, dirt, ash, etc.	3.7

* Unpublished data, Division of Technical Operations, Bureau of Solid Waste Values were determined from data taken in continental United States between 1966 and 1969. Published in Incinerator Guidelines-1969, U.S. Public Health Service, 1969

1. op. cit. page 48.

2. ibid.

ACTIVITIES-CONCEPT II (Cont'd.)

2. Garbage and trash in the schools

As the students are calculating the amount of garbage and trash being produced in the home, it will be interesting for them to calculate the amount of garbage and trash produced in the school. The students should work in small groups to investigate one problem of waste disposal in various areas of the school. Also, decide with which aspect of garbage and trash they wish to work. The following are examples but do not limit the students to only these:

1. How much garbage is discarded each day in an average classroom? Classify it in terms of paper, plastics, glass, metals, miscellaneous.

2. How much is discarded by the cafeteria daily? Classify it in terms of paper, plastics, glass, metals, miscellaneous.

3. Interview a janitor to find out how much garbage is discarded per day for the whole school.

4. Survey the students to find out if they feel that garbage is a problem in the school, and why they think it is or is not.

5. Find out what happens to paper after it leaves the school.

6. Could the paper that your school discards be recycled? Research this.

7. Interview the teachers to see if they are doing their part in conserving paper, etc. in the school.

After completion of these various aspects of school garbage problems, bring the class back together for a discussion. Using the data collected, figure the total weight of the garbage produced per week by your school. Using the population of your school (i.e. students plus teachers plus administrators plus maintenance people calculate the amount of garbage discarded per person per day at your school. Discuss the problem of garbage in the school and possible solutions to the problem.

ACTIVITIES - CONCEPT II (Cont'd.)

3. Small Group Activities (termination of solid waste problem)

Students should work in groups of three or four. They should choose a topic based on their interests as this provides self-motivation. Teacher may provide a list of suggested topics but this should not limit students.

1. List the things the family discards as to how much they have been used--once, twice, etc.

2. Classify things as to how long they have been used--1 day, 2 days, 1 month, 2 months, 1 year.

3. Calculate the amount of (volume and weight) garbage used in any city based on how much garbage you use per day. Assume all persons use the same amount as you.

   Check with the department of sanitation to see how much is collected per person per day.

4. Examine these problems. What would happen if the garbage is not collected for a period of time (say a month)? Possibly write a theme or story on this topic.

5. How rapidly is the garbage problem increasing? (See information on the next page -- data sheet-2C).

6. Outline in detail why garbage was not a problem in the past.

Name____________________

Date____________________

HOW RAPIDLY IS THE GARBAGE PROBLEM INCREASING?

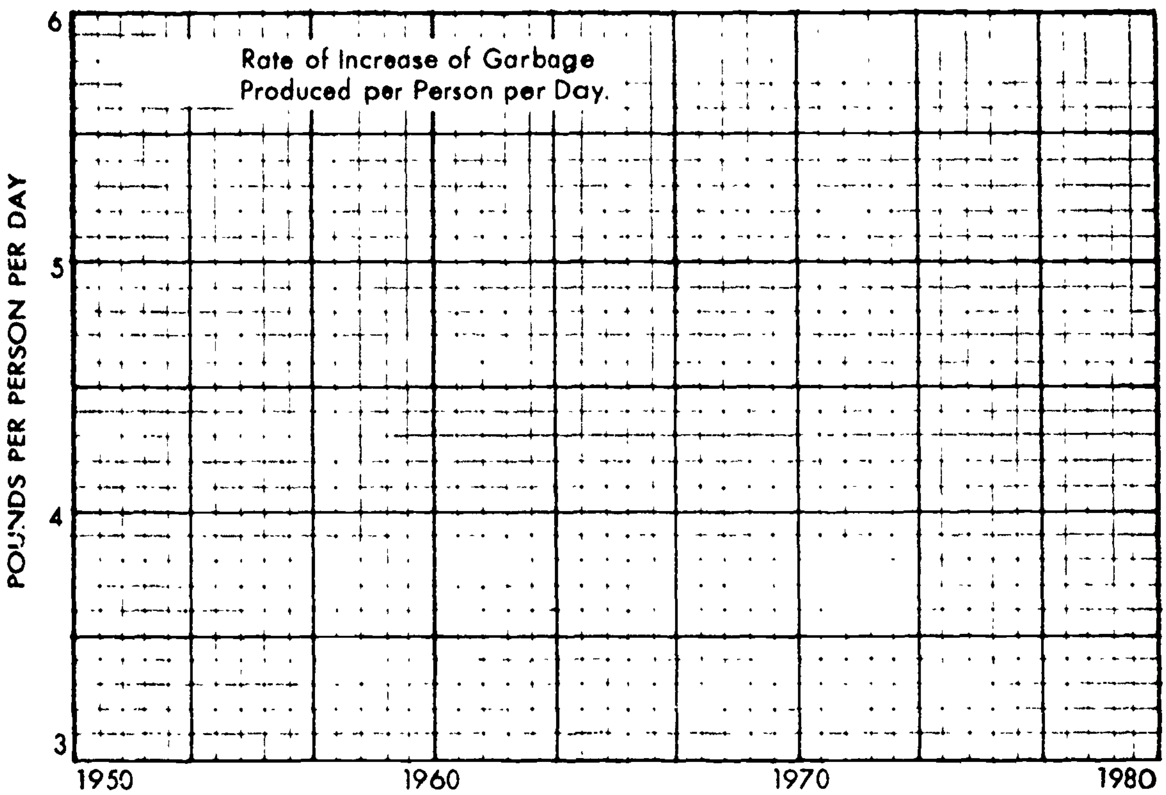
BEST COPY AVAILABLE

It has been said that Americans are producing garbage faster than people. What that means is that the amount of garbage discarded per person per day is increasing each year more rapidly than our population is increasing.

To see if that is happening in your community, obtain information about the amount of garbage collected annually. Also find out the population of your community each year for the past 20 or 25 years. Such information is available from the Department of Sanitation and the Bureau of Vital Statistics.

From those data, you can calculate the amount of garbage produced per person per year. Divide by 365, and you have the average amount of garbage produced per person per day. Now draw the curve on the chart in Figure 1.

Extend the curve to 1980. How many pounds of garbage will be produced per person per day in 1980? Is this more or less than in 1970? Can you explain what is causing this?



Extend the curve to 1980 How many pounds of garbage will be produced per person per day in 1980? Is this more or less than in 1970? Can you explain what is causing this?

From: Schatz, Albert and Vivian; Teaching Science with Garbage, pg. 55

ACTIVITIES - CONCEPT II Cont'd.)

4. Quality Life Activity

This activity is designed to help the students realize that recycling helps preserve our environment by reusing our resources. In this activity the teacher will ask certain KEY questions and manipulate these to reach the desired learning responses.

Questions

1. What is "Quality Life?" Ask the students to write in detail their desires. (Next ask the students to share their "quality life" with the other students.)

2. How many of you have a "quality life" as you have stated? Most will answer "no" -- this is a stepping stone to the next question.)

3. What environmental factors keep you from enjoying this kind of life? (Some students will suggest money; some population; some the quantity of resources, etc.)

4. Propose one way to alleviate each problem discussed in question three. (Some may say reduce population or increase the quantity of the resources. The teacher should manipulate the discussion until the students discover that one solution would be to make better use of the resources through recycling.)

The second part of the activity is an optional one. This will narrow our scope and focus on the resource of paper.

The first question is to ask the students if they believe that recycling will preserve our environment by reusing resources. Next ask the students to explain how it will help preserve our environment.

Using paper as an example of a product from the trees, ask the students how much paper they use each day; each week; each month; each year. Let the students estimate the numbers. Ask them if recycling the paper would help preserve the environment. Propose a situation that each student be allowed only 15 sheets of paper a week as a total allotment. Ask them to commit themselves to an activity like this, and limit themselves to using and reusing 15 sheets of paper per week for all classes. If they agree, you and your class must devise rules that all must follow. In this activity the teacher must mark each sheet of paper in a specific way to insure that they will abide by this. The students may find it easier to use a pencil and erase papers if more is needed. You should secure cooperation from the other teachers to accomplish this activity. Peer pressure should be used here to keep ALL honest.

This activity is designed to involve the students in the conserving and recycling of paper. Hopefully, it will point out that individuals must share the responsibility of conserving our resources.

5. An essay assignment (to reinforce the concept, if necessary).

   A million tons of solid waste is produced by St. Louis County residents every year. Why must you become involved in recycling this waste? What function does recycling play in our environment?

CONCEPT III

Man assumes his role as an integral part of the environment when he returns natural materials and synthetic materials to be reused.

BEHAVIORAL OBJECTIVE #3

50% of the students will be able to explain in a paragraph how man is an integral part of the environment when he returns natural materials and synthetic materials to be reused.

TEACHER BACKGROUND

In this concept, we hope that the student will see that man is the cause of the mess our environment is in and that man must clean up this problem. In this concept we hope to focus in on his role as it pertains to recycling. This borders on a value and to measure whether the students lives this role will be very difficult. For example, the teacher cannot measure if the student collects old newspapers and returns them to a recycling center. This is a commitment that the student makes on his own after completing the activities. It is possible, however, to measure the behavioral objective in a purely cognitive sense. For the student to simply know the relationship of man and his environment, when man makes an active effort to return natural materials to the earth.

Here is where the teacher begins to lead his students into helping the community by dealing with the solid waste disposal problem. Perhaps the students will pick a problem in which the entire class may plan an ecological approach to solving it. Or, perhaps, to widen their scope, the class may break down into four or five small groups and research or survey different aspects of the solid waste disposal problem.

Regardless of the avenue the teacher chooses, the emphasis must be on "Man's Role." What can be done to solve these problems, and as an individual what can the student himself do?

ACTIVITIES -- CONCEPT III

1. A Survey for Recycling

It is extremely important that the student realize that each individual has a role to play in the recycling process. Therefore, to find out if people do realize their responsibility, the students will make a survey of the people in the school or in the community. The students should choose a particular group to survey (all 15 year olds), prepare their own survey by devising their own questions, give the survey and analyze the results. General conclusions are to be drawn from the results. A discussion following the survey should be instrumental in assuring that each student realizes that man must assume his role as an integral part of the environment when he recycles.

The following questions are examples of questions asked by a 7th grader on the topic of recycling:

1. Do you think you have done enough to help stop pollution?
2. Do you use a recycling center?
3. If yes, what do you save to recycle?
4. If no, for question 4, why not?
5. Do you know where a recycling center in this area is located?
6. Would you pay higher taxes to support a recycling center?
7. Would you save things to be recycled if someone would pick them up for you?

2. One major activity for the unit is the involvement of the students in a recycling program -- (either the actual recycling or spreading information about recycling to other). This is an important activity because it will help the student realize one role in recycling our resources. This project can be done on the class as a whole or in a small group. The students should decide which they prefer.

Some examples of a class project are:

1. Conducting a paper drive
2. Setting up a recycling station
3. Making a pamphlet explaining recycling

4. writing columns for school paper on recycling

5. making bumper stickers to encourage people to recycle

Another example of a major activity is the planning and the execution of a "Pitch In" program sponsored by your class. The state director of the "Pitch In" program in Missouri will gladly come to the school and kick off the program. He often speaks before school assemblies. His name is Richard O. Gerges, United States Brewers Association, Inc. 915 Olive Street, St. Louis, Missouri 63101, Phone 421-5325

The "Pitch In" Program in the USA is sponsored by the U.S. Brewers Association.

3. Using data sheet 3 (on following page) a value lesson can solve from discussing the results of this sheet.

NAME________________________ Data Sheet 3

DATE________________________

Directions:

Compare the descriptions under each of the names and rank yourself by making a circle around the number which best describes your actions. A rank of one means you agree with the name on the left and a rank of five means you agree with the name on the right. Be prepared to discuss why you choose your position.

1. Returnable Ron 1 2 3 4 5
He uses only returnable containers and will not eat or drink anything that comes in a throw-away container.

No-deposit Norris
He uses only non-returnable containers because he thinks that returnables are too much trouble to take back.

2. Bike-riding Betty 1 2 3 4 5
She doesn't use any vehicles that pollute the air and therefore rides her bicycle to work 10 miles away each day.

Motoring Mable.
She uses motor vehicles at every chance she gets. She even retrieves the evening paper by taking the car down the half-mile driveway of her home.

3. Pure-air Paul 1 2 3 4 5
He is so opposed to air pollution that he takes short breaths so he won't add as much carbon dioxide to the air.

Polluting Polly
She is so unconcerned about air pollution that she burns cigarettes for incense.

4. Let-Live Larry 1 2 3 4 5
He is against any type of pesticide that he allows mosquitoes to bite him rather than spray at any time.

Pesticide Pete
He uses pesticides so freely that he sprays his house and backyard regularly to get rid of insects.

CONCEPT IV

Substances which are attacked by living organisms are biodegradable because they can be decomposed.

BEHAVIORAL OBJECTIVE #4

85% of the students will correctly fill in the blank. Substances which are attacked by living organisms and are decomposed are said to be _______________.

CONCEPT V

Plastics and other synthetic materials are non-biodegradable because they cannot be decomposed by living organisms.

BEHAVIORAL OBJECTIVE #5

85% of the students will select the correct term from a list of 4 possible terms for a material that cannot be decomposed by living organism.

TEACHER BACKGROUND

Much of the information concerning biodegradable and non-biodegradability is found along with the activities. But from simple observations around the school grounds the students should be able to see some example of biodegradable and non-biodegradable materials. For example, they should be able to find many different materials in different states of decomposition, (i.e. gum wrappers). Looking closely at these gum wrappers they should see that the paper is either completely or partially weathered away, but that the foil inner wrapping is completely intact. This is just one of the many examples of biodegradability that can be found on the school grounds.

The following article on biodegradability was presented by the plastics Products Division of Owens of Illinois on June 26, 1972. It gives their point of view which is not necessarily consistent with that of the authors of this paper. It is a biased view point that shows their side of the story, and since we are trying to be objective we feel the teacher should view both sides.

BIODEGRADABILITY

A biodegradable material is a material that is capable of being broken down by bacteria into more basic components. Most organic waste, such as food remains and paper, is biodegradable. This involves changing a material from one form into another and it is one of the laws of nature that little or no material is lost in this transformation.

In addition to biodegradability, there is thermo-degradability; chemical degradability; mechanical degradability; photodegradability; and many other methods to alter the form of a particular material. In many cases as this change takes place, it creates air and water pollutants that are harder to properly handle than the original solid waste material.

The purposed value of biodegradable material is that by reducing the volume of solid waste, it helps solve the waste problem and biodegrading material that is littered will solve the litter problem. But biodegrading takes time and no packaging material is really very biodegradable. Packaging had been developed as a method to preserve products and the very idea of making this material biodegradable in many cases negates the main function for which the material was originally developed. It is diametrically opposed to the concept of product integrity. In fact, as will be shown in the following summary biodegradability could be a negative factor in solid waste disposal.

Currently the principal methods of disposing of solid waste in this country are open dumps, sanitary landfills, incineration, pyrolysis, recycling and composting.

Open dumps are certainly not a satisfactory means of disposal and they are being converted as rapidly as possible to sanitary landfills. In many cases as biodegradation takes place, methane gas is released from dumps and landfills. This bacterial action frequently is a source of heat that cause fires. The chemicals released by rotting materials forms a leachate that can contaminate water supplies. When this material decomposes in the earth, it leaves voids that can make the ground unstable. This limits the future use that can be made of a site when dumping or landfilling is complete.

In the recycling operation the degradation of material means that the materials has probably been destroyed for use in a high value product. The place where biodegradation is a positive factor in solid waste disposal is in the aerobic digestion of organics and composting operations. Little material is currently composted and it is difficult to sell even the small amount that is currently produced.

People may feel that because a product is biodegradable it gives them a license to litter. This will certainly not solve the litter problem as this material is an aesthetic problem and will certainly not be tolerated while we are waiting for it to degrade. Not only that, but the change in material creates many health and safety problems. Biodegradability is certainly not a solution to the litter problem.

More and more packaging is being produced from more than one material. For instance, glass and plastic combinations; paper and wax combinations; plastic and paper combinations, in almost all forms of packaging. This coupled with the need in many cases for paper labels and metal and plastic caps on glass, metal and plastic containers makes us realize that packaging is really a multi-material business. Any list of our materials--glass, plastic, paper and metal-- shows that we should not promote biodegradability as the answer to either the litter or solid waste problem.

ACTIVITIES--IV AND V

Following this page are two activities entitled "Biodegradable" and "Mini" Landfills (data sheet 4 and 5). These may be reproduced for distributions among the students.

Name____________________

Date____________________

Data Sheet 4

BIODEGRADABILITY

Most organic compounds which occur naturally are produced by microbes, plants, and animals They therefore rot or decompose easily; in some cases, very rapidly. That happens with sugar, starch, and protein. Other substances such as wood, plastic, rubber, and leather decompose more slowly

Plastic, however, is not a naturally-occurring material It is not produced by microbes, plants, or animals Because it is made by man, it is spoken of as a synthetic material.

Synthetic textiles such as nylon and rayon, synthetic leather, and many synthetic insecticides, fungicides, and other pesticides are resistant to microbial attack.

Those substances have chemical structures which are different from the chemical structures of naturally-occurring compounds such as carbohydrates and proteins

For that reason, microbes generally do not possess enzymes or digestive juices which can degrade synthetic materials That is why many synthetic materials are resistant and do not compost If you tried plastic in your mold garden, you probably got no mold growth on it In your "mini" landfill, plastic persists almost indefinitely.

Substances which are attacked by microbes are said to be biodegradable because they can be broken down biologically: that is, by living microbes Plastics and many other synthetic substances are non-biodegradable They are not decomposed by living microbes.

DECOMPOSING SYNTHETIC COMPOUNDS

However, some synthetic compounds are biodegradable under certain conditions. You can demonstrate that process with certified dyes which are used as food colors. To carry out this experiment, add two heaping tablespoons of soil to each of five drinking glasses Fill them almost to the top with water, and stir to suspend the soil. Then let the soil settle for one, two, or three days until the liquid above the sediment is fairly clear

Now add a few drops of red, blue, green, and yellow food colors to the liquids Add only one color to each glass. The fifth glass without any food color is a control Stir gently to get the food color in each glass distributed uniformly throughout the liquid, but do not agitate the sediment.

Set up five more glasses the same way, but without soil Cover the glasses with

Taken from: "Teaching Science with Garbage," by Albert and Vivian Schatz, pg. 18 & 19.

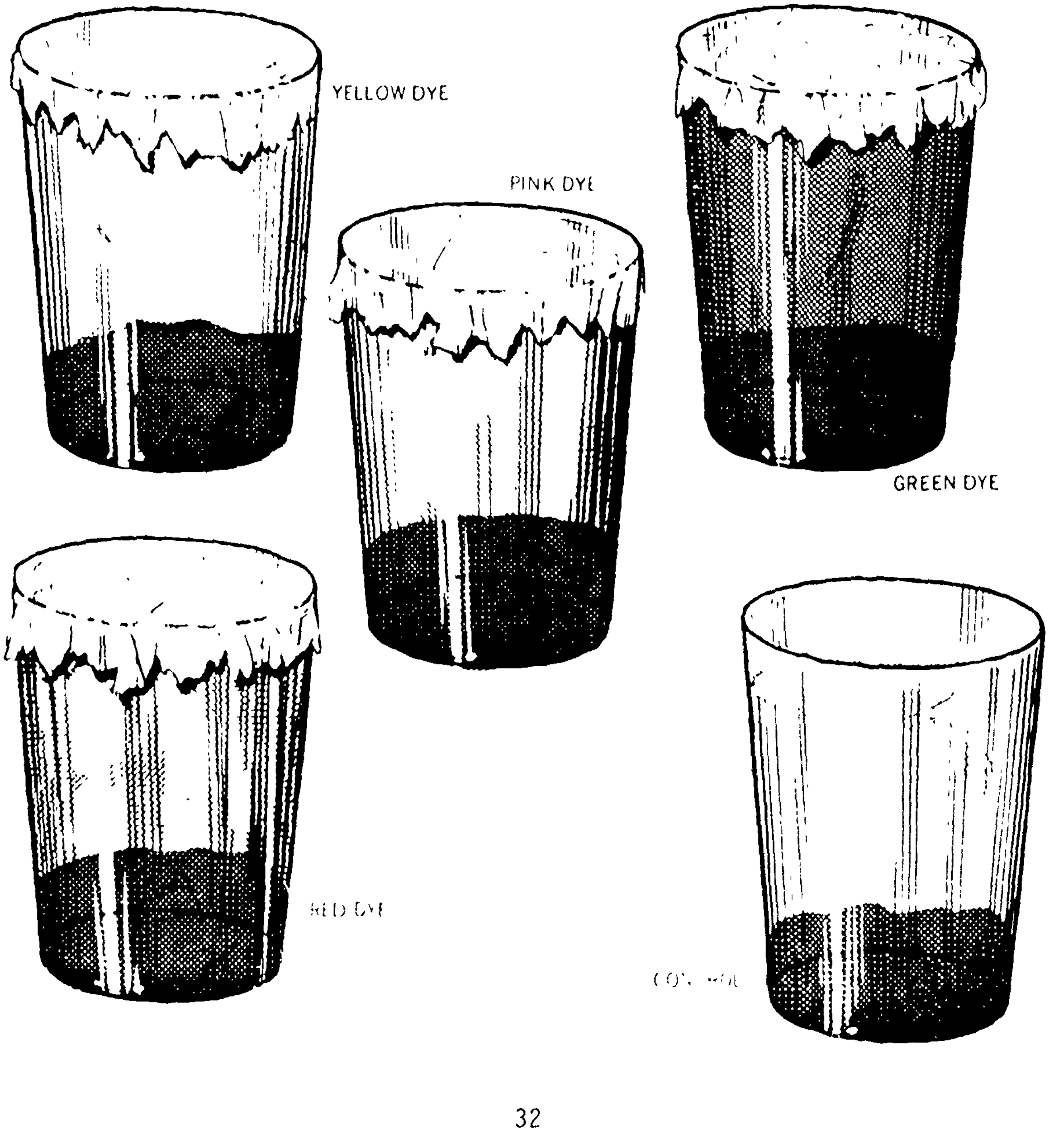
aluminum foil caps folded down snugly around the sides.

In a few days, the food colors in the presence of soil will begin to change color, and within a week or two may lose their color completely

That happens because certain bacteria in the soil can develop enzymes which break down or decompose the synthetic food color compounds The decomposition occurs even though the bacteria never came in contact with the particular synthetic materials before.

The bacteria are said to have adapted to the food colors. The new enzymes which they produce are called adaptive enzymes That is why some synthetic compounds like certain food colors can be composted.

They are therefore classified as biodegradable synthetic compounds The food colors in the glasses without soil did not change their color and become colorless Soil contains billions of microbes among which there are some, usually few in number, which can adapt to a synthetic compound Those few then multiply, and may eventually become the majority microbial population. As they grow on the food color, which serves as their food, they break it down chemically When that happens, it loses its color.



Name____________________

Date____________________

Data Sheet 5

"MINI" LANDFILLS

Some communitites dispose of their garbage by burying it and then covering it with a layer of soil. A place that is used that way is called a landfill.

Garbage therefore decomposes more slowly. In landfills where that occurs, paper and certain other materials have been recovered, without having changed very much, after 15 years, and in some cases even after 25 years.

CONSTRUCTING A "MINI" LANDFILL

You can set up a simple experiment to see what goes on inside a landfill, under the surface layer of soil. To do this, get three or four clear, transparent, tall glass or plastic containers. Ordinary drinking glasses are suitable. Use the same kind of soil and garbage items that went into your mold garden.

However, instead of putting the pieces of garbage on the surface of the soil, bury them at different depths. But in each case place them against the inner surface of the container so that you can see what happens. Leave an inch of air space over the firmly-packed soil. Keep the soil moist, but not puddled or water-logged. That will allow some aeration, but not as much as in the mold garden. Cover each container with a piece of aluminum foil folded down snugly around the outer sides.

Within a few days, mold growth will begin to develop.

Keep a record of how rapidly the different garbage items decompose in the "mini" landfill.

Can you detect organisms other than molds?

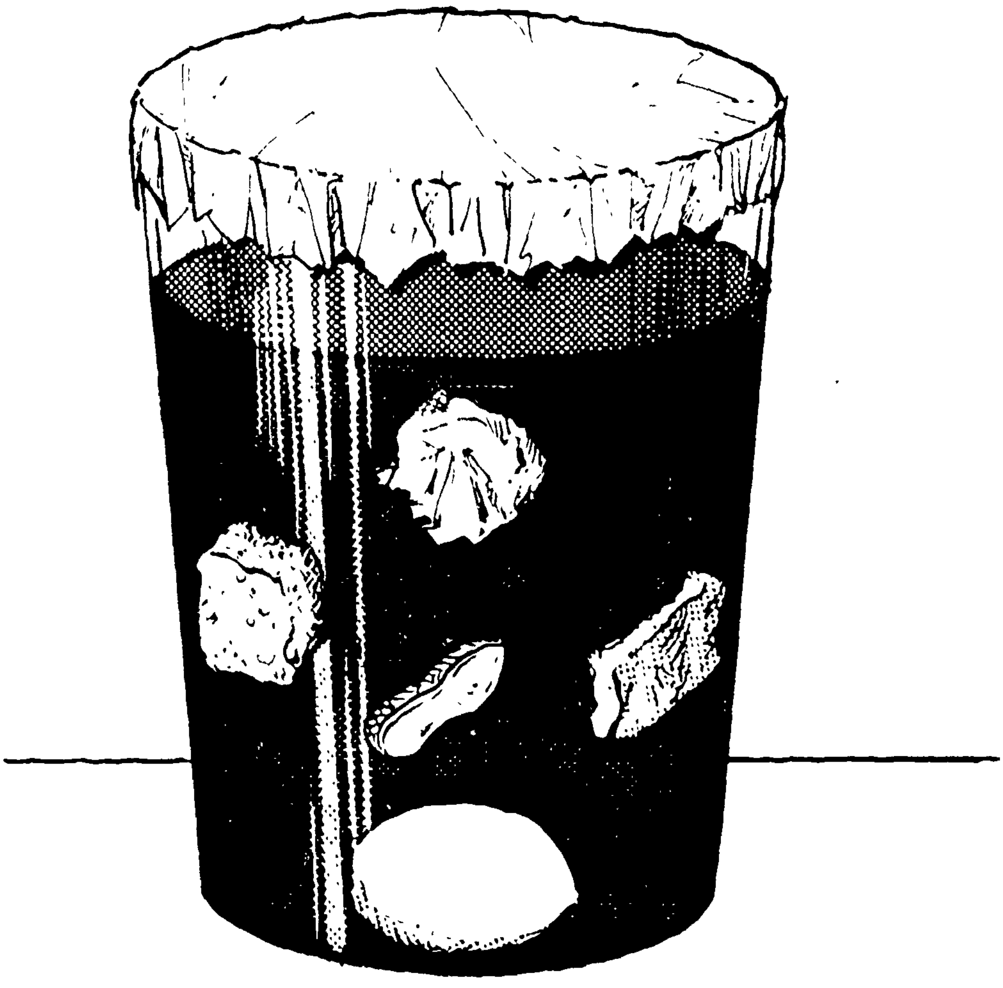
After some of the garbage materials are decomposed, you may notice empty spaces where they were. How can you account for those empty spaces? Are they really empty? Is there anything at all in these spaces? What happened to the bulk of the garbage materials which originally occupied these spaces? Where did those materials go?

One of the problems with landfills is that eventually the surface may settle and slowly sink. Explain how and why this could happen from what you observed in your "mini" landfills.

In Los Angeles, a landfill that was 90 to 100 feet deep sank 2.5 to 5.5 feet in three years. What would happen to houses built on a landfill? What could a landfill be used for once it was filled with garbage, and covered over with soil?

To dispose of garbage by landfilling requires an acre of ground seven feet deep for every 10,000 people every year. What is the population of your community? How many acres of land would be needed to landfill all the garbage that is produced over a ten year period in your community? Assume you can have a 14 foot deep layer of garbage.

EACH OF YOUR LANDFILLS SHOULD LOOK LIKE THIS



Taken from: "Teaching Science with Garbage," by Albert and Vivian Schatz, pg. 14-15.

Concept VI

Man copies nature by composting certain biodegradable materials

B.O.#6 70% of the students will be able to explain in a paragraph of 40 words or less how man copies nature by composting certain biodegradable materials.

Teacher Background

1. Garbage Is Gold; Compost Is Beautiful[1]

At the very base of the organic method lies compost. In its many forms and variations, compost is the beautiful substance which gives fertility to soil, productivity to plants, and health to man. It is the combination soil conditioner-fertilizer of the organic gardener, and the hub of all his gardening activities. If you are a successful compost maker, chances are 100 to 1 that you are a successful organic gardener.

In the past two decades, there has been a great amount of research in composting methods, resulting in the 14-day method, sheet composting, anaerobic methods, and many more variations of these. Behind them all, however, lies the original Indore method, invented by the father of organic gardening, Sir Albert Howard. The Indore method is still the most widely used, and is still practical and productive.

Sir Albert Howard found that by layering different organic materials, decomposition took place more quickly and more completely. He first placed down a 5 or 6-inch layer of green matter, then a 2-inch layer of manure (blood meal, bone meal, sewage sludge, or other high protein material may be substituted), and a layer of rich earth, ground limestone and phosphate rock. This simple formula produced a crumbly compost, rich in nutrient value and valuable as a soil structure builder. In further research, Howard found that a heap 5 to 10 feet wide, and 5 feet high was ideal (the length is optional). He also found that decomposition was facilitated by aeration, and so he placed pipes or thick stakes through the pile as it was being built, then pulled them out when the heap was 5 feet high. He then lightly pressed the entire outside surface to prevent blowing, formed a shallow basin on top to catch rainwater, covered the entire surface with a thin layer of earth, and left it to decay.

Organic gardeners have taken Howard's core of compost research and produced beautiful compost and beautiful gardens. Take the example of O. A. Severance of Watertown, New York, who transformed a completely unproductive piece of land into a lush garden spot, all through the use of compost. Mr. Severance makes compost in a pit, surrounded by a wall of loose field stone 7 feet square on the inside and 2 feet high. The wall is laid on top of the ground, and the soil inside is dug out a foot deep.

Into this pit go hen and stable manure, leaves, weeds, garbage, lawn clippings, sunflower stalks, some sod, and ground limestone. This pit, layered according to Howard's Indore process, is level with the top of the stones when it is completed. Severance turns the pile in 3 weeks when he estimates the temperature has reached 150 degrees. Four weeks later he turns the pile again, in order to be sure all material has a chance to get into the center of the heap where decomposition is proceeding most rapidly. In a total of 3 months, he takes out well over 2 tons of finished compost. In this way he can make 2 piles each season.

From experimenting, gardeners often find ways to improve the Indore method, at least in their own gardens. Lois Hebble of Decatur, Indiana, uses a strip composting method. In the middle of the growing season, she lays heaps of organic materials on top of vegetable rows from which she has just harvested early crops. The material is partially composted by the next spring, but is not broken down enough for small seeds. Into these rows she plants melons, squash, or cucumbers.

Compost

Other gardeners use variations of the earthworm bed, sheet composting, mulching, pits, bins, plastic, shredding, and numerous devices in trying to find the best method for them. You, too, can experiment with different methods to find *your* way of composting. But remember that the key to success is the Indore method. Learn it well and anything is possible.

2. Helpful Hints on Compost Making

When to make compost

In temperate climate zones, autumn is generally the most suitable time to make compost. Among the reasons for this are:

1. Garden production is completed for the season; time and attention can more readily be given to preparing humus.
2. Plant wastes, leaves, and various other organic materials are plentiful and easily available.
3. Either finished or partially decomposed compost can be readied and applied to all sections of the garden with minimum effort or interference and with ample time to replenish the soil well before spring planting.

October and November are excellent for making compost heaps or pits because at no other time of the year are plant materials more abundant for this purpose. Garden wastes, autumnal leaves, roadside weeds, wastes from food-processing plants, and other materials are easy to obtain at this time of year. Also by making the compost heap then, the compost will be ready for use at spring garden making time.

Compost, however, can and should be made during any part of the year. In subtropical climes, any time is best for compost making. In the North, however, you often have extremely dry summers, when the decaying process is held up. We recently made a pit of compost of very resistant ingredients—shredded corncobs and leaves—in the middle of the winter, and by July it had been turned into wonderful compost, with earthworms doing the mixing. During the winter warm spells, compost can be made in a pit. The pit sides keep it warm and accelerate the decay processes in the winter. It wouldn't pay to assemble a compost heap in the open.

For winter composting, pile up the manure with a covering of soil and burlap bags or canvas. Also have available, in a protected place, topsoil and green matter that are not frozen. Leaves that have been gathered in the fall are excellent.

If you do have to make a compost in the open during winter, choose a protected place, as on the south side of a building or wall. You could also make a protective barrier of corn stalks tied together. An extra heavy layer of soil on top would help, or a very heavy hay or straw mulch a few feet thick to keep the heap warm.

1. Rodale, Robert: The Basic Book of Organic Gardening. pp 59-60.

BEST COPY AVAILABLE

What grinding does

Grinding is the key to quick composting. What grinding materials actually does is greatly increase the total surface area of the material. The conversion of raw organic matter into colloidal humus is accomplished by a series of fermentations. These fermentations consume the plant and animal residues like a living fire. The finer the particles, the faster they will be consumed. In breaking up a large particle into smaller particles, the volume decreases so much faster than the surface that in finely ground matter the ratio of surface to volume is very great. It is the large surface and relatively small volume of the fine particles that makes it possible to make finished compost in so short a time as from 3 to 5 days. The same principle applies to the burning of such a substance as charcoal. A large piece of charcoal may burn for hours or even days. If the piece of charcoal is reduced to a fine dust, complete combustion will be accomplished in a fraction of a second with explosive force. The compost made in less time than one week will be even better than that made over a period of months, because there is less time for the dissipation of valuable gases and the leaching out of essential elements.

Ventilating the heap

It is absolutely essential that the compost heap be well ventilated so that there is a sufficient flow of gases between the atmosphere and the interior of the compost heap. The soil organisms which break down the plant and animal residues and convert them into compost are aerobes, i.e., they must have the oxygen from the atmosphere to carry on their life activities. Here is a suggestion for a simple but effective way of ventilating the heap. As soon as the pits have been dug or the soil has otherwise been prepared for the compost heaps, a number of ordinary fence posts are set up and held in position by driving 3 small stakes around the base of each post. The posts are placed where the ventilators are desired. By using chalk or heavy pencil, marks can be made on the posts 8 inches apart to serve as a guide in building the various layers of the heap; 6 inches for plant material, 2 inches for the fresh manure, a sprinkling of raw ground limestone, and a ¼ inch or less of good earth. When the heap has been built to its usual height of 5 feet, the posts are pulled out to form the ventilating chimneys. To facilitate the removal of the posts, a board can be laid on the heap to serve as a walk, and a cross piece nailed near the top of the post to serve as a handle to pull out the post. The size of the ventilator is determined by the size of the post used.

Where to make compost

There are no set rules on the best place to make compost. We know of gardeners with imagination who have set up a composting area on their front lawns in such a way that it added to the overall attractiveness. For the most part, though, gardeners prefer to do their compost making in back of their lots, where the heap can be easily "disguised" in some way.

For example, on one suburban place, the home owner chose an area behind the fireplace alongside the rail fence at the rear of the property. It's just a few yards from the vegetable patch, so it's a simple procedure to carry weeds, plant wastes, etc., to the pile, as well as take the finished compost to the garden.

Just as important, whenever large quantities of waste organic materials are available, it's a simple job to drive up the alley at the end of the yard and dump the materials directly onto the heap. So in that case the composting area has these three advantages:

1. It fits into the landscaping plan without being an eyesore.
2. It's close to the source of organic waste materials and to where most of the compost is used.
3. It's little work to bring in outside materials, since they can be dumped directly from a car or truck.

There are a great many ways to improve the appearance of composting areas on your own home grounds. There are wooden bins specially designed for this purpose, where the slats are removable for easy withdrawal of the finished compost. Many gardeners we know use cement blocks, often without mortaring them together, around 2 or 3 sides of the heap. (Hay bales make an excellent "door" on the fourth side). Still others make use of hedges to "fence off" their home fertilizer factories.

What you decide to do depends a great deal on the size of your grounds. If you have several acres there's probably little need to think about disguising the heap, your main objective is to choose an idea that's accessible and large enough to make all the compost you need.

On the other hand, if you live in a highly developed suburban area with fussy neighbors, you'll want to be extra careful. Besides the camouflage techniques mentioned previously, you might want to think about making compost in pits.

Here's an idea which John Adamson of East Lansing, Michigan, recently sent in, one that might suggest a solution for your own composting problems.

> I've been trying to come up with a systematic arrangement for making regular use of kitchen and garden refuse. What I have in mind are sunken dual compost heaps, that is, two pits side by side. These are to be dug in the rear of my garden, surrounded by shrubbery for screening and protection. The rectangular depressions are to be about 2 feet deep, 2 feet wide, and 4 feet long, with wooden covers to go over them to keep the neighborhood dogs from scattering the contents, and to keep these receptacles from filling up with snow in the winter season.
>
> In a surburban area as I live in, it would not be acceptable to try to maintain my compost on top of the ground, even with 3 framed sides. The dimensions mentioned would provide relatively small compost heaps, to be sure, but half a loaf is better than none, and I can get away with this size and also get a more rapid turnover than if they were larger.

The main thing to remember is that in just about every yard, there *is* space for composting.

Collecting and assembling materials

When it comes to getting materials for your compost heap, the big point is to use imagination and initiative. You'll have a certain amount of waste materials available without moving off your home grounds, such as grass clippings, garden residues, leaves, weeds, kitchen wastes, and so on. If these supply you with enough of the vegetable matter for your composting, that's fine. But don't feel that you are limited to just those sources. If you need more, there are scores of places within a short drive of your home where valuable wastes are available—for the most part *free*.

Adding earthworms to the compost heap has also been found an effective way of hastening decomposition.

Watering and turning

When the materials are shredded in the 10–14 day composting technique, it's relatively easy to turn the heap with a pitchfork, so you can do it as often as time permits. However, the heap should be turned at least twice during the first 14 days.

If the materials are not shredded and you want finished compost as fast as possible, it's best to keep the heaps relatively small so they can be turned often without too much effort.

Regarding watering, it's especially important to have the heap quite moist during the initial days. It's well to have the top of the heap sloping toward the center, so that rainwater and water from a hose will seep down through the heap. A good practice is to check the heap at regular intervals to make sure the heap is always moist.

Mistakes to avoid[1]

Most people get in trouble with their compost heaps by making them of one ingredient. They make a pile of only leaves or weeds, or grass clippings and are disappointed when nothing happens. Last year we made a test heap consisting only of shredded hay. Although we kept this heap moist and turned it frequently, little decomposition took place. It's essential to add some nitrogen-rich material such as fresh or dried manure, dried blood or compost previously made, or even a small amount of rich soil, because the nitrogen in these materials is needed food for the decomposing bacteria.

Just as important as not letting the heap dry up, is not keeping it in a perpetually soggy condition.

Difficulties can arise also if the compost heap is too large. Five feet is about the right height, as it allows air to get into every spot, provided that the heap is not too wide either (no more than 10 to 12 feet wide at the bottom, generally not less than 5 feet).

During the winter months, little decomposition usually takes place in the heap because of the cold. Many gardeners get around this by covering the heap with burlap bags or canvas, or by even using soil.

How to tell when finished 2

Some people think the finished product of their composting process should be crumbly like old leaf mold, but generally we're satisfied with a compost in which the straw, grass clippings, and more refractory substances such as cornstalks are broken up and have a rich, dark color.

When we apply compost, the mass is crumbly, not soggy; very often, on close inspection, you can determine its origin. Of course, if you're in no rush to use the compost, there's no harm in letting the compost break down into finer material. For ordinary gardening purposes, this is not necessary though, since the final decay can take place right in the ground. For flower growing, especially potted plants and for starting seedlings, it's good to screen the rougher material or to use the finer material which develops later.

When and how to use compost 3

Many gardeners schedule their compost applications about a month before planting, when the materials are decomposed and rather fine. Others "double up" on their composting production by applying it half finished, or notably fibrous, in the fall, and allowing it to break down right in the soil. In this way, they can make a second compost heap in the same space as the first and have twice as much finished compost by the time spring comes.

For general application, the soil should be turned thoroughly; then the compost is added to the top 4 inches of soil. When adding compost to growing crops, it can be mixed with topsoil and together applied as a mulch, so the roots of established plants will not be disturbed. This procedure is called a topdressing of compost

Compost should be applied annually—anywhere from 1 to 3 inches in thickness. You can get by with less, but in gardening with small plots put it on heavily. [illegible] a guide, an average figure of weight for one cubic [illegible] compost is 1,000 pounds.

BEST COPY AVAILABLE

Fourteen-day Method[4]

Day-to-day to two-week compost

First day. Your basic material can be one of a number: leaves, spoiled hay, weeds, or grass clippings. To this should be added one of the nitrogenous materials (manure is best) and any other material available. In the editorial experiments, equal parts of leaves, grass clippings, and manure, with a liberal sprinkling of natural rock powders, were found to work very well. Remember, too, that leaves tend to mat down, slowing the composting process; they should be mixed with other material. Shred everything, including the manure, with a compost shredder or a rotary mower; mix materials together and place in a mounded heap. If your materials are low in nitrogen, be sure to add a sprinkling of dried blood, cottonseed meal, or other nitrogen supplement on each series of layers.

Second and third days. By now, the heap should have begun to heat up. If not, add more nitrogen. Bury a thermometer in the heap to check temperature. Keep the heap moist, but not soggy.

Fourth day. Turn the heap, check temperature, and keep moist.

Seventh day. Turn it again, check temperature, and keep moist.

Tenth day. Turn it once more. The heap should now begin to cool off, indicating that it is nearly finished.

Fourteenth day. The compost is ready for use. It will not look like fine humus, but the straw, clippings, and other materials will have been broken down into a rich, dark, crumbly substance. You may want to allow the heap to decay further, but at this stage it is perfectly good for garden use.

1. op cit. pg 66.
2. ibid, pg 67.
3. ibid, pg 68
4. ibid, pg 70-71.

BEST COPY AVAILABLE

Manure 1

The most common domestic animals which are a source of manure are horses, cattle, goats, sheep, pigs, rabbits, and poultry. The dung consists of the undigested portions of the foods which have been ground into fine bits and saturated with digestive juices in the alimentary tract. It also contains a large population of bacteria which may make up as much as 30 percent of its mass. Dung contains, as a rule, 1/3 of the total nitrogen, 1/5 of the total potash, and nearly all of the phosphoric acid voided by the animals.

Percentages of Nitrogen, Phosphate, and Potash in Different Manures

KIND OF ANIMAL MANURE	% NITROGEN	% PHOSPHATE	% POTASH
rabbit	2.4	1.4	0.6
hen	1.1	0.8	0.5
sheep	0.7	0.3	0.9
steer	0.7	0.3	0.4
horse	0.7	0.3	0.6
duck	0.6	1.4	0.5
cow	0.6	0.2	0.5
pig	0.5	0.3	0.5

How to Use Compost 2

Your compost is finished. After carefully following the recommended steps for turning the year's bounty of organic material into rich, mellow humus, you want to be certain that it's used right—that it benefits your soil most and helps to insure a natural abundance and health in your coming crops.

Let's examine some of the better methods of garden compost application. By doing so, perhaps many people who have recently begun gardening the organic way will find a number of very practical and worthwhile suggestions on making the optimum use of nature's valuable fertilizer. Even those who are "old hands" at tilling the land and following the recommendations of the organic method may discover some downright helpful ideas and hints.

When to apply

The principal factor in determining when to apply compost is its condition. If it is half finished, or noticeably fibrous, it could well be applied in October or November. By spring it will have completed its decomposition in the soil itself and be ready to supply growth nutrients to the earliest plantings made. Otherwise, for general soil enrichment, the ideal time of application is a month or so before planting. The closer to planting time it is incorporated, the more it should be ground up or worked over thoroughly with a hoe to shred it fine. A number of garden cultivating tools and machine equipment offer an excellent time-and-labor-saving hand in accomplishing this. Several will help spread it evenly and mix it thoroughly with the soil.

If your compost is ready in the fall and is not intended to be used until the spring, it should be kept covered and stored in a protected place. If it is kept for a long period during the summer, the finished compost should be watered from time to time.

How to apply

For general application, the soil should be stirred or turned thoroughly. Then the compost is added to the top 4 inches of soil. For flower and vegetable gardening, it is best to pass the compost through a ½-inch sieve. Coarse material remaining may then be put into another compost heap.

SUMMARY

The student should see composting as a method of recycling that is both practically and ecologically sound. Man indeed does copy nature when he composts. The student should realize that composting is a way that he can help ease the environment problem.

1. op, cit, page 82
2. ibid, page 83

ACTIVITIES--CONCEPT VI.

1. Construction of a compost pile.

Planning the compost pile should be a total class activity. If possible the class should go out of doors and choose a site. The materials to be used should be decided on by the entire class. The entire class should be encouraged to bring garbage, grass clippings, etc. to be used in the compost pile. Once the planning has been done one group in the class can be assigned the task of building the compost bin. Another group might be assigned the job of adding materials to the pile as they are brought in. For students that show interest an additional activity is to take temperature readings periodically of the center of the compost pile. The data can then be graphed.

Following the preparation of the compost pile, the students should discuss how composting compares to the natural decaying process. They should see composting as a natural recycling method which they can employ in the home.

In looking for decay one should look for change in color. Decaying materials turn brown. As the process continues the color deepens. Evidence of organisms helping the process will be found. Worms, flies, maggots, beetles, ants, and termites might be present. It is possible that an odor might accompany decay. Also, this is due to a number of factors including the bacteria and the amount of heat and moisture present.

2. (Optional)

After the compost pile has decayed, the students can use this fertile material to fertilize the ground around bushes or trees on the school grounds. The process of applying composted materials to the ground around the plants is called mulching.

3. (Optional)

You might invite a speaker to talk on composting. Many parents compost so this presents you with an opportunity to have parents come to class and share their wealth of information. Mr. Joe Seibert, 322 Hill Avenue, Manchester, Missouri (Telephone 227-1686) would be a very interesting person to invite to your class on this subject.

4. Following these pages are two articles on the history of composting. Copy these articles and have the students read them and discuss them. (Data Sheet 6)

GEORGE WASHINGTON -- COMPOST SCIENTIST

In George Washington's time, garbage was not the problem it is today. There were fewer people. Food did not come in cans. Paper was not as widely used as it is today. Bottles were not discarded. Plastic did not exist Much more space was available where things could be thrown away, and left to rot. But more than that, people lived differently then. Their way of life is described by this New England adage.

Eat it up.
Wear it out.
Make it do.
Do without.

Nevertheless, those early Americans made compost, usually with animal manures and some other kinds of organic matter, mostly for agricultural use. The end product was applied to the soil in an effort to increase crop yields.

George Washington experimented with composting in this way, and if he were alive today, he'd be an organic farmer and a staunch advocate of composting!

One thing he was very interested in was building up and conserving the fertility of the soil. This is clearly revealed in the book *George Washington, Farmer*, written by Paul L. Haworth in 1915.

After the Revolutionary War ended, one of Washington's main concerns was the restoration of the land on his plantation. For this purpose, he wanted to hire a farm manager, but one with very special qualifications Washington wrote that the kind of man he was looking for had to be "above all. like Midas. one who can convert everything he touches into manure, as the first transmutation toward gold; in a word, one who can bring worn-out and gullied lands into good tilth in the shortest time."

According to Haworth, Washington "saved manure as if it were already so much gold, and hoped with its use and with judicious rotation of crops to accomplish" that. In 1794, Washington himself wrote that "Unless some such practice as this prevails, my fields will be growing worse and worse every year, until the crops will not defray the expense of the culture of them."

Washington was also concerned with composting. This is revealed by an experiment which he recorded in his diary on April 14, 1760. The following report of how he carried out this experiment and the results which he obtained is in his own words:

"Mixed my compost in a box with the apartments in the following manner, viz.

"No. 1 is three pecks of earth brought from below the hill out of the 46-acre field without any mixture.

"In No. 2 is two pecks of sand earth and one of marle taken out of the said field, which marle seemed a little inclined to sand.

"3 has two pecks of sand earth and one of river sand.

"4 has a peck of Horse Dung.

"5 has mud taken out of the creek.

"6 has cow dung.

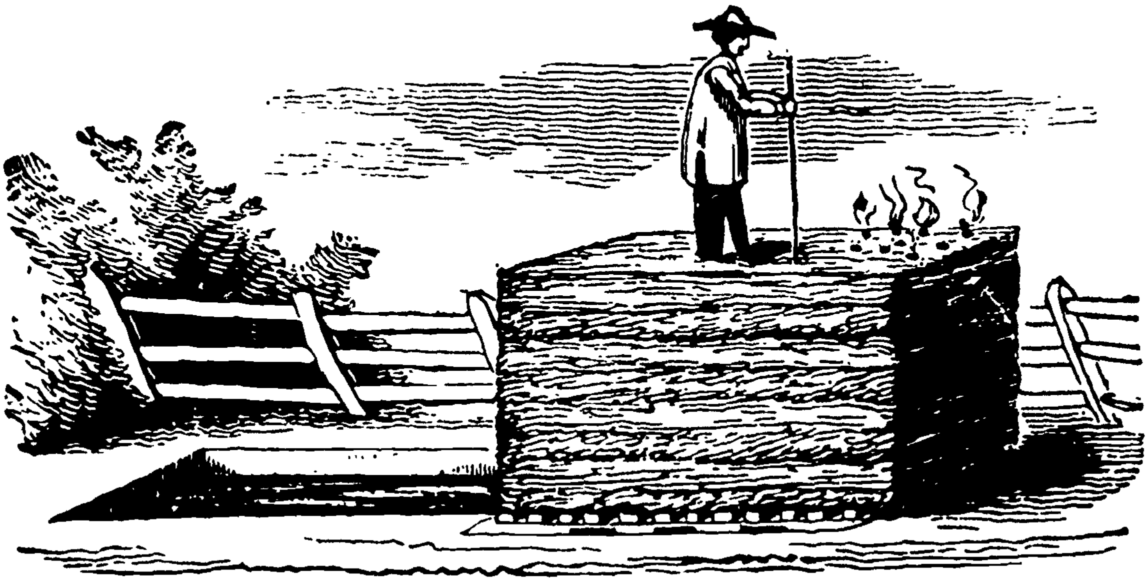
"7 has marle from the Gulleys on the hillside, which seemed to be purer than the other.

"8 sheep dung.

"9 black mould from the Gulleys on the hillside which seemed to be purer than the other.

"10 Clay got just below the garden.

Taken from: "Teaching Science with Garbage," by Albert and Vivian Schatz, pg. 20-21.



Back in the 1840's, this is how a compost pile looked as designed and built by George Bommer. He recommended punching holes in the heap for complete bacterial action.

"All mixed with the same quantity and sort of earth in the most effective manner by reducing the whole to a tolerable degree of fineness and rubbing them well together on a cloth In each of these divisions were planted three grains of wheat, 3 of oats, and as many of barley, all of equal distances in Rows and of equal depth done by a machine made for the purpose. The wheat rows are next the numbered side, the oats in the middle, and the barley on the side next the upper part of the Garden. Two or three hours after sowing in this manner, and about an hour before sunset I watered them all equally alike with water that had been standing in a tub about two hours exposed to the sun."

Washington kept this experiment going for three weeks. He then concluded that Nos. 8 and 9 gave the best results.

DID COMPOSTS PROVIDE ANCIENT MAN WITH FIRE?

How was the use of fire one of Man's most fundamental discoveries actually made? In this report, a British anthropologist develops his theory that "a simple solution is provided by the warmth of a composting heap."

DR. DAVID C. ARNOLD
Lecturer in Biology
City of Portsmouth Training College
Portsmouth, England

In a brief communication published elsewhere[1], I put forward the suggestion that heat engendered by the bacterial decomposition of plant material might have played a significant role in discovery of the use of fire. This possible origin of one of Man's most fundamental discoveries, a discovery which enabled him to dominate his environment in a way unparalleled by other animals, deserves somewhat fuller discussion since I have been informed that at a meeting of the West African Science Association in 1958 it was reported that natives had been seen to obtain fire from rotting vegetation left by subsiding flood waters. It would be most interesting to know just how widespread this custom is in Africa and elsewhere, and whether the possibility of obtaining fire in this way is known also to tribes whose members customarily use other methods of ignition or maintain permanent fires.

Study of existing cultures shows clearly how important is knowledge of the production and control of fire, even to the simplest and most undemanding of primitive communities. On a large scale it is used to drive animals toward the waiting hunters, or to clear areas of bush as a means of primitive agriculture. On a domestic scale it provides warmth and light, two factors which have enabled Man to withstand the rigours of colder climates and to prolong the length of his working day. In primitive industries fire is used to harden wood, shatter stone and work metal, while in cooking it increases the number of materials which can be utilized as food and enables some of them to be preserved for future use. However, despite its importance throughout human history, we have no direct evidence about the means by which fire was originally produced, nor is such evidence to be expected in the future, for though the bones of fossil men have often been found with the ashes of their hearths and the charred bones of animals, fire destroys its own origin and none of their other artifacts indicates the source of their domestic fires.

The earliest attempt to explain the origin of the use of fire is perhaps that of Lucretius[2], who suggested that knowledge of fire-production might have been gained from observation of dry branches swaying in the wind which, by continuously rubbing together, might generate sufficient heat to set the wood on fire. Later theories [3, 4, 5] have been based on rather similar arguments. Some authors suggest that fire was first obtained as a result of observation of the effects of natural friction or percussion, others that it was "domesticated" from such sources as volcanoes or forest fires. Evidence for these hypotheses is obtained largely from study of primitive tribes, presumed to be uninfluenced by the major civilizations,

Taken from: "Teaching Science with Garbage," by Albert and Vivian Schatz, pg. 24-28.

and from comparative mythology. Certain tribes have been described as entirely lacking any native means of fire-production. Such communities have tended their fires with the utmost care and, on the occasions when these have been accidentally extinguished, have not attempted to strike fire afresh, but have gone to great lengths to obtain it from other sources. Again, mythology abounds in descriptions of the origin of the use of fire, descriptions which imply a frictional or percussive origin, or involve a hero who obtains fire from the gods. This latter myth, of which the Prometheus legend is a familiar example, clearly suggests domestication of fire from natural sources.

However, these theories have several disadvantages. In the first place, a myth is not a description of an event, but an interpretation by a later thinker. In a sense, therefore, the fire myth is merely an hypothesis put forward by a prehistoric anthropologist. The behaviour of existing tribes may be equally difficult to interpret. However primitive a race may seem, it still has a long history behind it and its members are far removed in time, and probably in thought, from ancestral fire-producers. Moreover, throughout historic times fire has received widespread veneration as the emanation of a god, or as a god itself. The perpetual fire is a familiar religious symbol and to many races the domestic hearth has been to some extent a domestic altar as well. Thus a ceremonial interpretation may also be put upon the re-establishment of one domestic fire from another or from a natural source, without in any way implying that this was always the means employed to obtain fire. Finally, all existing races (together with many of the more recent fossil men) are regarded by most biologists as members of a single species, *Homo sapiens*. This implies not only genetic, but also cultural, interrelationship. But Man as we know him today is not alone in the use of fire,

"Teaching Science with Garbage," by Albert and Vivian Schatz.

for it was regularly used by Neanderthal Man (*Homo neanderthalensis*), whose later members were co-existent with and perhaps gave rise to our own species, and by the much earlier species *Pithecanthropus erectus*[6]. Consideration of the origin of domestic fire must not only take into account the present species, but also the earlier species of Man and Manlike animals from whom neither myth nor culture now survive.

How could these earliest of men have conceived the use of fire? Clearly it must have been known to them as a natural force. However, natural fires are mainly of a terrifying and destructive kind. Even modern Man feels fear when confronted with a bush fire or active volcano. Less sophisticated than ourselves, early Man is even more likely to have reacted to these phenomena by head-long flight. In any event, the process of obtaining fire from such sources involves difficulties which can be overcome only by a technology which early Man is unlikely to have possessed. It might be argued that Man would have to possess fire before he could obtain it from natural sources. It is possible that fire could have been obtained somewhat more easily from burning jets of natural gas, many of which ignite at a relatively low temperature, but such jets occur only in restricted areas and the problem of how the fire could be transported still remains. The natural production of fire by friction or percussion is rare indeed and thus unlikely to have attracted the attention of members of small and scattered communities. Furthermore, artificial fire-production by these means seems to require a degree of preparation and persistence which are quite improbable unless the use of small-scale fire is already well established.

The problem is thus resolved into the question of how fire could have been produced within or close to the habitations of early Man in a manner at once easy and natural, without at the same time becoming dangerous or terrifying. A simple solution is provided by the warmth of a compost heap. On this hypothesis use of fire would have been preceded by use of heat derived from the bacterial decomposition of plant material, most probably of bedding. That this process of decay can generate sufficient heat to produce fire is common knowledge, for spontaneous combustion of haystacks or garden compost heaps is by no means rare. Quite a number of mammals (for example, the European badger) gather plant material as bedding and it is reasonable to assume that early Man did the same. So long as he led a purely nomadic existence this material would not accumulate to a sufficient extent for bacterial action to become important, but as soon as a more settled mode of life was adopted decay would significantly increase the warmth of the bed. The remains of both *Pithecanthropus* and Neanderthal Man have been found in caves and rock shelters, indicating that both species remained in one area for extended periods, even if the sites were not permanently inhabited. In the confined space of a cave a communal bed, replenished at intervals with sun-dried vegetation, would be the logical sleeping accommodation and would provide conditions suitable for growth of the bacteria. Once the increased warmth of a well-established bed had been noted, efforts would be made to promote this condition. At times such beds would burst into flames. This event would fulfill the conditions suggested as necessary for the establishment of domestic fire, for it would be startling rather than terrifying, inconvenient rather than dangerous, while its immediate cause would be obvious to the community as a whole, not just to a single individual.

Apart from depending upon natural processes instead of upon interpretation of existing cultures and myths, this the-

ory has the advantage that it does not presuppose so high a degree of initiative or intelligence as do those previously advanced. This is important when one remembers the rather small cranial capacity of the earlier Man-like creatures. For example, *Pithecanthropus* (which seems to have walked erect and used crude stone tools) had a cranial capacity averaging about 900 c.c., in comparison with 500 c.c. for the gorilla and approximately 1500 c.c. for Neanderthal and Modern Man. Though cranial capacity cannot be correlated directly with intelligence, the mental processes of *Pithecanthropus* were certainly more limited than are our own, perhaps closer to those of modern apes.

If this "compost heap" theory of the origin of the use of fire is accepted, certain other aspects of Man's attitude to fire can readily be fitted into the scheme, without the conflicts implicit in other hypotheses. Discovery of charcoal and earth-oven cooking could stem directly from the "compost heap" situation. As wood and stone-working industries were developed the heating effects of friction and percussion would become apparent. Once the relationship between heat and fire had been recognized, new and quicker methods of ignition might be invented as a by-product of these industries. Domestication of natural fire would also be of later date than fire-production through bacterial decay and would have a ritual character. This is important, for unless they had separate origins, veneration and domestic use of fire are really antagonistic concepts. However, so soon as it was realized that the small domestic fire is similar in kind to that found in nature, the way would be open for veneration of the hearth itself as a symbol of the greater fire. Such veneration would logically take the form of maintaining a perpetual fire, in imitation of permanent natural fires. By this means, establishment of new fires from pre-existing ones would come to be preferred to the original means of fire-production.

Present theories of the origin of domestic fire are that it was first obtained from natural sources, or that ignition was achieved by application of friction or percussion techniques invented through observation of natural events. These theories are based largely upon consideration of the cultures or myths of existing races, all of whom are regarded as members of the same species. Apart from the inherent difficulties of the interpretation of such circumstantial evidence, these theories do not take into account the fact that fire was certainly used by earlier species with mental characteristics perhaps nearer to those of modern apes than to even the most primitive of modern men.

It is therefore suggested that use of fire was preceded by and arose from use of heat produced by the bacterial decomposition of plant material. If early Man used sun-dried vegetation as bedding for any reasonably prolonged period, something akin to the compost heap or haystack might well have been formed. This would provide a direct introduction, apparent to the whole community, to the value of heat. Through occasional spontaneous combustion the use of a blazing fire would then have been discovered.

This sequence of events does not involve the technical and psychological problems presented by the rarity of small-scale fire-production in nature and the awe-inspiring character of most natural fires. On this theory, use of friction and percussion would be a later discovery, probably as a by-product of tool-making industries.

The "compost heap" theory also resolves certain difficulties in the interpretation of fire myths, which in their present form indicate both use and veneration of fire. The degree of antagonism between these concepts vanishes if it is considered that they had separate ori-

gins and that use of heat and fire were established before Man realized the fundamental similarity between natural and domestic fires. At this point the care needed to maintain an effective compost heap as a source of fire would be united with the ritual symbolism of perpetual fire. Subsequently, as sophistication increased, the original means of fire-production would naturally be abandoned for either the technically quicker methods of ignition by friction or percussion, or the symbolically more satisfying process of "domestication" of natural fire.

1. Arnold, D. C. "Possible Origin for the Use of Fire by Early Man." *Nature, Lond.*, 192: 1318 (1961).

2. Latham, R. F. (Trans.) "Lucretius: the Nature of the Universe." Penguin Books Ltd.: London. (1951).

3. Graves, H. G. "The Invention of Fire." *J. Roy. Asiat. Soc. Bengal*, 12: 1 (1916).

4. Hough, W. "Fire as an Agent in Human Culture." *U. S. Nat. Mus. Bull.*, 139: 1 (1926).

5. Huntington, E. Article on "Fire" in the Encyclopedia Britannica. (1959).

6. "Handbook on Evolution." British Museum: London. (1958).

7. Romer, A. S. "Vertebrate Paleontology." Univ. of Chicago Press, Chicago, Ill. (1945).

CONCEPT VII

Materials which are non-biodegradable can be made useful by man's technology.

BEHAVIORAL OBJECTIVE #7

65% of the students will explain how two biodegradable materials can be made useful through man's technology.

TEACHER BACKGROUND

In this concept our aim is to show what man is doing to solve the problem of disposal of non-biodegradable materials, and what he will be doing in the future. As is stated, approximately 90% of this material is disposed of by landfills and incinerators. Our assumption is that with the increasing air pollution laws and a shortage of available land, man's technology must develop new ways to dispose of our non-biodegradable waste.

In our activities we have stressed the idea that the student can make use of many items instead of throwing them away. We feel that to survive on this planet, man must make a better use of this growing resource--namely "trash."

The following teacher background information is taken from:

1. Environment: December, 1970
   By Robert R. Grinstead, Pages 3-17

2. Solid Waste Management Study 1968 and
   Plan 1970 Pages VI-6 to VI-8, and
   VI-14.

"Trash Is Our Only Growing Resource"

United States Under Secretary of the Interior, Hollis Dole told participants "Trash is our only growing resources" at a conference on solid wastes in Houston last March. This point of view is becoming increasingly prevalent among public officials, scientists, and businessmen concerned with the problem of what to do with the growing mountains of solid waste accumulating in a 1 around cities in the United States.

Getting rid of trash has been a problem since the first cavemen threw a broken bone into the nearest bush. The solutions developed by the earliest men -- burning, burying, or carting the material somewhere out of the way -- are still the major methods in use today, albeit with some new twists. While these practices presented few problems for cavemen, the modern trinity of escalating population, intensifying concentration in urban centers and skyrocketing consumption of material goods has fashioned a triple threat to the age-old practice of dumping wastes onto the nearest unoccupied space. Gradually as the awareness of air pollution and public health problems has dawned, the plumes of smoke which used to identify local dumps have been disappearing; these eyesores have largely been replaced by landfills, where raw waste is quickly covered with a layer of earth. Currently, about 90 per cent of the trash collected in the United States is disposed of either by open dumping and burning or by landfilling. The latter has proven a fairly satisfactory means of solid waste disposal, since the land use has been of low economic value, and since the filled areas remain available for numerous uses, particularly recreational ones.

The landfill process, however, is a ravenous devourer of land. New York City has been consuming land for this purpose at the rate of about 200 acres a year. Some cities including San Francisco, have already run out of space and are shipping their trash to other areas. Others have switched to incinerators, by which the volume of trash can be reduced substantially to a mineral residue, extending the life and improving the quality of the landfill site by several fold.

The incinerator is not without its problems however. Faced with the increasingly rigid air pollution restrictions on one side, increasing corrosiveness of flue gases produced by certain plastics on another, and increasing capital and operating costs as a result of these two problems, the incinerator may well find itself becoming obsolete before it becomes fashionable.

Presented with this dilemma, authorities are thinking a good deal about longer range solutions, and support is beginning to crystallize around the concept of reclamation or recycling, as it is more popularly known. Rather than viewing trash as a useless waste to be stored away somewhere, the recycling concept views it as a resource to be exploited, as Under Secretary Dole suggested.

Stated in these terms, three powerful reasons support the recycling approach; first, the waste material is diminished or eliminated; second, credit may be obtained toward the cost of managing the waste material; and third, pressure on the corresponding virgin material source is reduced.

Recycling, which literally means returning to the beginning of the cycle, suggests separating the trash into its components which may then be returned to the place of manufacture; for example, paper waste may be remade into paper products, tin cans returned to the steel mill, and bottles to the glass furnace.

However, it is not necessary to return the components of trash to their original form in order to obtain some further usefullness from them, and the aim of current recycling efforts is simply to return the wastes to the economy in a way that will provide some utility in any form.

With this definition, even landfilling can be termed a recycling use. Los Angeles, for example, has filled pits and gullies on which have been built golf courses and a botanical garden. Virginia Beach, Virginia is building a 60 foot hill of trash on which will be constructed an amphitheater, a soapbox derby run, and a winter sledding course. Yet the value of fill-around one dollar per ton - is rather nominal considering the relatively expensive materials which went into the trash. The question really is: can we utilize trash in a more valuable way, and if so, how much more?

(1) "Description of Some of the Recycling Technology Processes"

There are a large number of technology feasible processes for recycling solid waste. Almost all of them, however, are made up of basic building blocks of technology, which we shall refer to as unit processes. The unit processes which are most frequently mentioned for solid waste recycling plants are the following:

a. Grinding
b. Air Classification
c. Magnetic Separation
d. Incinerator
e. Pyrolysis
f. Landfill

a. Grinding or crushing, is simply a process by which the particle size of the entering material is reduced. This is usually done by means of a hammer-mill, a device consisting of a rotating vertical shaft inside a hollow cylinder. The solid waste falls down in the annulus between the cylinder and the shaft. The rotating shaft has attached to it a large number of hammers, which pummel the solid waste during its passage down the annulus. As would be expected the cost of grinding is strongly related to the degree of reduction in particle size achieved. For the reduction of solid waste to material which will pass through 4 inch square holes in appropriate cost is $0.35-0.75 per ton. To grind solid waste so that it will pass through 1 inch square holes cost $0.75 to $1.00 per ton.

Grinding is almost (though not quite) a prerequisite for the other process steps. Solid waste is after all, an extremely heterogeneous material in terms of size, and the juxtaposition in space of an object as small as a cigarette package with an object as large as a television set is not uncommon. Thus, even to utilize such a simple device as a conveyer requires pregrinding.

b. Air classification is a method by which a material of heterogenous size and composition can be classified (i.e., separated into fraction of differing size and composition) by means of passage into an air stream, the air stream contained within a vertical duct. The materials with a lower density and a larger surface area tends to go upward, with the air stream, while heavier and lower surface area materials tend to fall downward. Thus each air classifier produces two fractions, and the fractions are far from pure when food material is as hetergenous as solid waste (even if it has been preground). Nonetheless, two or three of these devices in series can classify solid waste to a reasonable degree.

c. In magnetic separation, the solid waste is merely passed along a conveyer belt with a strong magnet at the end, then non-ferrous components will simply drop off the end, while the ferrous can be held on for another foot or so and then dropped off.

d. Incineration

Incineration qualifies as a recycling process on two counts; heat recovery during burning and material recovery from the residue. Incinerators with steam generation equipment for power production have been in use in Europe for many years, and new installations in the United States are beginning to adopt this improvement. In this instance, of course, paper serves as fuel which is of relatively low value compared to the potential value of paper listed in Table 1. (See Next Page).

The incinerator is still an evolving species, and some newer designs involve such variations as gas turbines to generate power, or very high temperatures to melt and further shrink the volume of residue.

The major source of reclaimed values from incineration might, however, lie in the residue, which in a well-operated installation, would have a composition given in Table 2. (See next Page).

United States Bureau of Mines' scientists have developed a process utilizing relatively simple equipment (mainly screens and magnetic devices) which separates the major portions of this residue. In addition, a very high-intensity magnet separates the colored (iron-containing) glass from the clear glass. Costs of operating this process are estimated to be only about four dollars per ton of residue. Although the value of the products has not yet been established, it will probably exceed the four-dollar-per-ton processing costs and it seems very likely that in concert with the generation of power, incineration might be brought close to the break even point.

The attractiveness of incineration at the present time is that it can reduce trash to somewhere between 10 and 20 per cent of the original volume. For more advanced "slagging" incinerators which operate at high enough temperatures to produce molten residue, the volume is shrunk to only 2 to 3 per cent of the original. Even with no reclamation of the residue, the life of an existing landfill site can thus be increased severalfold.

TABLE 1
Potential Values in Trash

		Potential Value of Component	
	Per Cent by Weight	$/Ton of Components	$/Ton Trash
Paper, Paperboard	50	100	50
Ferrous metal	9	20	2
Aluminum	1	200	2
Glass, Ceramics	10	10	1
Garbage, Yard Waste	20	5*	1
Misc; Plastics, Textiles, etc.	10	5*	0.50

*Value as compost
**Value as fuel

TABLE 2

Composition of Typical Municipal Incinerator Residue

(Average of five Washington, D. C. Incinerators)

Material	Per Cent by Weight
Tin cans	17
Other iron and steel	11
Other metals	2
Glass	44
Ceramics, stones, bricks	2
Partially burned or unburned organic matter	9
Ash	15

Source: United States Bureau of Mines Report 7204, 1968

About 90 per cent of the trash collected in the U.S. is disposed of either by open dumping and burning or by landfilling.

While the burning of trash has thus come along way from the smoldering city dump of a generation ago, the major problem with incinerators is still air pollution. Equipped with a variety of scrubbers, filters, and precipitators, existing technology can probably cope with the increasingly strict air pollution standards in urban areas, but the question is whether it can be done economically in the face of other alternatives.

e. Pyrolysis is a method in which the solid waste is heated to a high temperature (900-1500 $^{\circ}$F.) in the absence of air. This results in the decomposition of the organic material present into hydrocarbon gases and liquids, and a residue of something very much like charcoal (ordinary charcoal is produced by burning wood in the absence of air). The hydrocarbon gases, which can be readily burned are produced in sufficient quantity to generate enough heat to carry out the pyrolysis step. Thus, no outside fuel is required. The current status of pyrolysis in solid waste processing is not clear, partly because it is not clear what can be done with the products. Nonetheless, the probability that it offers a significant potential for solid waste processing is attested to by the fact the Enviro-Chem Systems, Inc., a subdivision of Monsanto Chemical Corp., have offered to build a pyrolysis based solid waste processing plant for the city of New York (31).

Monsanto's research indicated that the capital cost of a 1,000 ton per day plant is 10 million dollars. In 1969, incinerator investment costs were some $6,500. per ton, and with elaborate air pollution control equipment, they would be more on the order of $7,500. to $8,000 per ton. Thus the capital costs of pyrolysis equipment is about the same (allowing for some inflation since 1969) as for incineration equipment. Total costs are competitive with a well designed municipal incinerator (92).

Perhaps, the most significant features about the proposed plant are the manifest signs of confidence in the process given by Monsanto, one of the Country's largest and most respected chemical engineering based firms. Monsanto has proposed building a 1,000 ton/day plan for the City of New York and has agreed to offer the City three options (31).

1. Monsanto will own and operate the plant over a long period and the City will pay a pre-set price per ton and the refuse handled.

2. The City can purchase the plant at an agreed price and Monsanto will operate it at a pre-set price per ton.

3. The City can purchase the plant at an agreed price and the City will itself operate the plant.

It seems clear that Monsanto feels that they have pyrolysis technology well in hand. Certainly, any city which doubts the feasibility of the Monsanto process can easily shift all the risk to Monsanto. We conclude that pyrolysis is a technologically feasible method for disposing of refuse. The price of running a pyrolysis unit we roughly estimate as being comparable to incineration, or about $7 - $10 per ton (92).

f.[1] The landfill method has the advantage of being inexpensive and applicable to a wide variety of terrains. It may be utilized in low swampy areas or tidelands to raise the elevation and reclaim the land for other use. It may also be used to steep terrain to fill canyons or depressions. The popularity and widespread use of landfill disposal has been due to:

1. The availability of suitable low-cost land such as canyons, nonproductive lands, and marshlands.

2. Low capital outlay and cost of operation.

3. Traditional acceptance by the public.

4. Its adaptability and flexibility to accept a wide variety of wastes of varying composition and amount with no pretreatment required.

Some of the disadvantages and problems encountered by this disposal method are:

1. Rising land cost and critical competition for usage of available land resulting in difficulty in site acquisitions.

2. Growing pressure by conservation interests against use of certain open spaces as disposal sites.

3. Increasing urban pressure requiring more stringent operating controls.

There are several classes or types of landfills ranging from sanitary landfills down to open dumps. These two extremes illustrate the range between "controlled" and "uncontrolled" landfilling. Controlled landfills include those sites at which all or most of the materials are routinely buried. As the name would imply, control is exercised over the wastes; type of materials accepted at the site may be restricted; dumping operations are confined to one portion of the site; and a program of compaction and covering retains materials in the site.

Terminology used in this report to designate specific types of controlled landfills includes "sanitary landfill", modified sanitary landfill", and "modified sanitary landfill with burning". Uncontrolled landfills include burning dumps at which control of the solid wastes is virtually lacking. Terms used in this report to designate these sites are "uncontrolled burning dump" and "supervised dump with burning."

The most acceptable form of landfill, from a public health point of view is the sanitary landfill. Although a number of specific variations in construction procedure are used depending on the terrain, it is generally a process of dumping and compacting the solid wastes to the smallest practical volume and covering them daily with compacted earth in a systematic and sanitary manner. In this method, wastes are spread in thin layers, and compacted by mechanical equipment until a lift 5-15 feet deep is achieved. At the end of each day an intermediate earth cover is applied and compacted. Subsequent lifts of refuse may be placed over each lift with intervening layers of earth cover until the height limit of the site is reached. Final cover of the fill consists of a minimum of two feet of compacted earth. While landfill is by far the most commonly used method of disposal, only 67 sited in the stated were classified as sanitary landfills.

The more common form of controlled landfilling encountered in California is some type of "modified" sanitary landfill (138 sites). This form of landfilling involves periodic covering of the refuse but not usually at daily intervals. Included are sites where the top surface of the fill is covered each day, but the face of the fill is left open. Also, included are the sites where the fill is only covered every two or three days. In essence, a modified sanitary landfill follows the sanitary landfill construction procedures with the major exception of daily covering of all exposed solid wastes. This kind of operation is not compatible with urbanized land use. There may also be some burning of selected combustible materials at modified sanitary landfills, such as seasonal accumulations of brush and hard to handle items such as long pieces of lumber.

Open dumps (the opposite of "controlled" landfills) are the most prevalent type of disposal site used in the state. All but seven counties have at least one such operation with a statewide total of 511 sites (71 per cent). This type of operation is usually accompanied by continuous or periodic burning and these disposal sites have minimal organization and operating procedure. The refuse is dumped on the ground, over a bank or into a trench and burned in place. In many sites equipment is used only when dumping or entrance to the site is impaired by the accumulation of burned-over refuse.

The large number of open dumps found in California is due to:

1. Minimum amount of land required.

2. Essentially no development or operating cost.

3. Lack of environmental quality control standards.

This type of disposal site has many disadvantages, some of which are:

1. Creation of health and safety hazards through breeding of flies and rats; air pollution; odors and unsightlyness.

2. Creating land blight and reduction of adjacent property values.

3. Increasing urban pressure requiring more remote location of these sites and difficulty in obtaining sites.

4. Generally poor aesthetic conditions.

SALVAGE AND RECLAMATION

The terms salvage and reclamation include a number of disposal processes: sorting of refuse for metals, tin cans, glass, paper and cardboard that may have a local market; reduction of garbage or rendering of animal wastes for fats, tankage and other products; use of swill, garbage, and food processing wastes for animal feed; salvage of automobile bodies and scrap metal; and the reclamation of miscellaneous industrial wastes.

Salvage and reclamation cannot be considered exclusively as a means of disposal but is usually a part of another disposal process. Many of the disposal sites in the state salvage metals and other materials with varying degrees of organization. One commercial salvage company operates magnetic separators at several controlled landfill sites to remove tin cans. Many tons of cans are salvaged and reclaimed for use in the copper industry. A large amount of waste paper and cardboard amounting to many thousands of tons per year are salvaged and processed through centralized baling stations. In some cases paper is also salvaged at disposal sites.

1. California Solid Waste Management Study 1968-1970, pg. VI-6, VI-7, VI-8 and VI-14.

Research Efforts in Recycling

There are a number of new efforts now under way to develop improved techniques for recycling, and some efforts which had previously received little public attention are now receiving intensive examination to determine how they might contribute to a solution to the solid waste problem. Because of the rapid development of interest in the area, any attempt to identify all relevant efforts must necessarily fail. However, it is worth reviewing briefly some of these efforts. A brief listing includes the following projects.

a) The Bureau of Mines of the Department of the Interior has a pilot plant study under way of a method to recover metals and glass from ordinary municipal incinerator refuse (104).

b) The Bureau of Mines also is initiating a pilot plant study for recovering paper, metals, and glass from municipal solid waste (105).

c) The Black Clawson Corp. has a pilot plant for the recovery of cellulosic fiber from municipal solid waste, and the reduction of volume of the remainder of the materials (21, 22, 23).

d) The Forest Products Laboratory of the USDA is initiating a study of methods for recovering fibrous material from solid waste, for conversion to usable paper products.

e) Stanford Research Institute is studying the possibilities of utilizing air classification equipment to classify solid waste into separate and usable categories (93).

f) Hercules Corp. is constructing for the State of Delaware an integrated solid waste disposal-recovery system. The organic portion of the wastes will be composted, while the remainder will be recovered into a number of usable products. This plant definitely does not fall under the category of an ordinary composting plant. Rather it is a totally integrated recycling plant, one of whose products is compost (113).

g) Monsanto Enviro-Chemical Systems, Inc., has a 35 ton/day pyrolysis pilot plant in St. Louis, Missouri. While pyrolysis is mainly used in this case to drastically reduce the volume of solid waste, pyrolysis is widely discussed as a means of recovering usable products from solid waste, so much work along these lines can be expected. Moreover, Monsanto is proposing, as part of its overall pyrolysis based waste handling method, to recover ferrous metals (31).

h) The United States Atomic Energy Commission is studying the possibility of eventually recovering the original materials in solid waste in their elemental form (i.e., carbon, oxygen, iron, chromium, etc.) by the use of the yet to be developed fusion torch. While this research is for the long term, it is nevertheless important (45).

i) The Garden State Paper Company has successfully initiated systems incorporating a combination of voluntary household separation of waste, separate collection of the newspapers, and finally reprocessing back into usable newsprint (97).

j) The Franklin Research Institute in Philadelphia, has under way an experimental program to test out a design for the separation of commercially acceptable waste paper from solid waste (95).

BEST COPY AVAILABLE

Eco-Centers Revisited

IN MAY 1971, a list of the collection points for old newspapers, bottles and cans in the St. Louis area was published on the Challenges Page.

Since that time, several collection points have closed and others have been established. The following is a revised list of recycling stations.

Affton — Christ Memorial Church, 9712 Tesson Ferry Road, papers on weekdays; Salem Lutheran Church, 8343 Gravois Road, papers on the every fourth weekend of the month.

Brentwood — Brentwood Congregational Church, 2400 South Brentwood Boulevard, papers anytime.

Bel Ridge — Bel Acres Shopping Center, Natural Bridge and Springdale Roads, papers, glass and cans on the second weekend of the month.

Clayton — Southwest end of Shaw Park, 217 South Brentwood Boulevard, papers, glass and cans anytime.

Crestwood — Sappington Road five blocks north of City Hall, papers, glass and cans from 9 to 11:30 a.m. and 2 to 4 p.m. on Mondays, Wednesdays and Fridays, 9 a.m. to 4 p.m. Saturdays.

Creve Coeur — A & P Supermarket, 776 North New Ballas Road, papers anytime; Dierberg's Market, 11505 Olive Boulevard, papers anytime.

Ferguson — City Hall, 110 Church Street, papers, glass and cans anytime.

Florissant — Old St. Ferdinand Shrine, Rue St. Francis and St. Charles Street, papers, glass and cans on the third weekend of the month from 9 a.m. to 3 p.m.

Hazelwood — City Hall, 8150 Pershall Road, papers, glass and cans anytime.

Kirkwood — 350 South Taylor Avenue, papers, glass and cans anytime.

Ladue — City Hall, 9345 Clayton Road, papers on the third weekend of the month.

Lemay — St. Francis of Assisi Church, 4550 Telegraph Road, papers on the third weekend of the month.

Normandy — Normandy Shopping Center, Natural Bridge and Lucas and Hunt Roads, cans on the first Saturday of the month.

Olivette — City Hall, 9473 Olive Boulevard, papers, glass and cans anytime;

Overland — Northeast corner of Lackland and Woodson roads, papers anytime.

Riverview Gardens — Gibson Elementary School, Fonda and Chambers Roads, glass anytime.

St. Charles — Immanuel Lutheran Church, Sixth and Jefferson Streets, papers on the fourth weekend of the month.

St. Louis — Skinker-De-Baliviere Community Council, 6008 Kingsbury Avenue, papers, glass and cans on the second weekend of the month; Ebenezer Lutheran Church, 1011 Theobald Avenue, papers on the third weekend; Holy Family Catholic Church, 4125 Humphrey Avenue, papers on the third weekend; St. John's Lutheran Church, 3738 Morganford Road, papers on the second weekend; St. Pius V Catholic Church, South Grand Boulevard and Utah Street, papers on the third weekend; Union Methodist Church, 3543 Watson Road, papers on the second weekend.

Shrewsbury — Explorer Scout Post, 3701 Melbourne Avenue, papers and glass on the second weekend of the month.

University City — Hanley Junior High School, 951 North Hanley Road, papers, glass and cans during daylight hours.

Webster **Groves** — Webster Groves YMCA, 226 East Lockwood Avenue, glass and cans anytime; Geggus Market, 748 Marshall Avenue, glass anytime; Yorkshire Shopping Center, Highway 66 and Laclede Station Road, glass anytime; Jansen's Market, 551 West Kirkham Road, glass anytime.[1]

[1] St. Louis Post-Dispatch, Tuesday, July 18, 1972.

New Attitudes and Technologies Needed

In very general terms, the roadblock to recycling our trash has been the attitude that materials are to be used once and discarded, and that the management of the waste piles thus created can somehow be taken care of.

Thanks to the new awareness of and concern about the environment, this attitude is changing. But we are finding that more than attitudes may need changing if many of our environmental problems are to be solved.

Looking at the trash problem, one of the major deficiencies seems to be that our materials technology needs to be extended to include the production of materials not only from virgin sources, but also from wastes. A tree contains about 50 percent cellulose fiber, just about the same as a truckload of urban trash. Yet we get most of our paper from trees, because, at our present state of knowledge, it is simply less expensive to do so. A large part of the reason for this is that the technology of papermaking arose at a time when wastes were almost nonexistent and virgin sources unchallenged. The technologies of papermaking, steelmaking, glassmaking, and numerous other industries, have all been laboriously constructed over many decades to their present highly refined state on a foundation of virgin material. Yet to a hypothetical scientist from outer space, unfamiliar with our history, there would seem to be a priori reason why we could not, with adequate research effort, utilize the 50 percent of cellulose fiber, or, for that matter, the glass, iron, aluminum, and other materials in the trash.

Thus we need, among other things, new attitudes about producing materials which will be reused, rather than discarded after a single pass through the economy. But we need just as badly some new technology for salvaging these materials from wastes. This will cost money, and it will take time. It is at this point that the need for federal government activity becomes visible.

The Solid Waste Act of 1965 placed the primary responsibility for dealing with the solid waste problem in the Bureau of Solid Wastes Management (BSWM) in the Department of Health, Education and Welfare, some additional duties for mineral and fuel wastes being given to the Bureau of Mines in the Department of the Interior. The interest at that time was nominal by current standards of funding, and the total budgets of these two agencies have since then amounted to only about fifteen million dollars per year. Much of the effort of the BSWM during this initial period was devoted simply to assessing the problem and the existing means for dealing with it.

The mood is now shifting. A bill introduced in Congress in 1969 by Senator Muskie to extend the Solid Waste Act of 1965 was buffeted about for over a year and emerged as the Resource Recovery Act of 1969. Development of technology for recycling of materials is a major emphasis in this bill, for which $461 million was authorized, several times the 1968 budget for solid wastes. While expenditures are thus authorized,

funds have yet to be appropriated, and the sincerity of Congress will be more adequately measured by the extent to which their appropriations match their rhetoric.

Two changes in our official attitudes seem called for, if we are serious about increasing our utilization of waste materials. First, we need to treat waste material industries on at least an equal basis with virgin material industries. In fact, until the technology of recycling matures, we may have to go a step further and favor it for a time, using such devices as subsidies for waste material industries, and a reduction or elimination of existing depletion allowances, favored tax positions, and lower freight rates for virgin materials.

The second change would be the establishment of some sort of feedback between the disposal process and the material manufacturing process. Thus, while it may be perfectly possible to come up with ways to recycle currently available materials, in the absence of restraints, the rapid appearance of new items in our trash cans may outstrip the ability of the waste processor to separate and reclaim them.

If the material producer can somehow be given at least part of the responsibility for the disposal problem, a powerful brake on extravagance would exist. At this time, however, no consensus has been reached on how to do this.

The role of the federal government in this field so far has thus been neither carrot nor stick-neither taxes nor incentives - for the management of trash and solid wastes. It is, to pursue the analogy, rather more like the shovel, which through the support of research and development, is smoothing the path along which the proverbial animal must tread. Plenty of carrot-and-stick legislation has been discussed and even introduced in Congress and state legislatures to accomplish a variety of ends. Few bills have actually been passed into law, because in this rapidly developing field it is not clear how the government should play its regulatory and incentive cards.

ACTIVITIES - CONCEPT VII

1. The students will choose a nonbiodegradable container (plastic bottle, egg carton, glass bottle, etc.) and will turn it into an art project. For example, make a collage from different materials, make flowers from egg cartons, etc. Please allow for individual creativity.

2. Hand out copies of the data sheet 7a on waste materials and discuss possibilities of reusing wastes in this manner (see next page).

3. (Optional) Extended project--make soap according to the directions found on data sheets 7b "Recycle Fats, Make Your Own Soap".

4. Secure a speaker from various companies in the area that are involved in research program in recycling.

   a. Mr. Edward Shel.y -- Alton Board Box Company (telephone 227-1100).

   b. Owen's Illinois in the division of glass or plastics will send a man (phone 863-0840).

   c. Alcoa may have a person to send (phone 863-0300).

   d. Any company will probably send a representative to discuss recycling.

5. Debate the issues concerned with a landfill. Let the students present the pros and cons of a landfill. Contact Mr. John Schneider from the County Health Department for information. He is their expert on landfills. (telephone 726-1100)

6. There are several films available on technology of recycling.

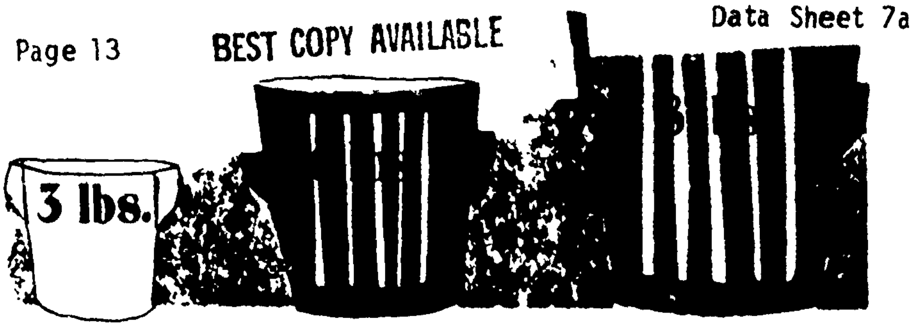
   a. "Things Worth Saving"

   b. "Litter and Solid Waste--An Objective View"

   c. "The Garbage Explosion"

   Sources for these are listed in film bibliography.

RECYCLING WASTES



Save raw materials, solve waste problems

THE U.S.A. IS the most wasteful nation the earth has ever seen. Each American throws out a ton of garbage and wastepaper every year. This huge, rapidly growing monster called Solid Waste is overwhelming our cities.

Landfill space is running out, so we can't bury it. Big cities are finding that rural communities don't want *their* garbage. Incinerators to burn it cannot keep pace with the overwhelming mass, and they also pollute the air with present poor technology.

Recycling of wastes is essential. Bottles can be reused; cans can be recycled. Junked autos already provide more than half of the steel for new cars. Recycled paper already saves 200 million trees a year, and that could easily be doubled. And in the future, garbage may be processed into a crude oil.

More citizens are becoming involved in recycling – and it takes hand-sorting of cans, bottles and paper to make it work. In Madison, Wisconsin, a year-long salvage drive saved 50% more paper for recycling . . . paper that otherwise would have taken up 10,000 cubic feet of landfill. In the U.S. over 70 million cans were returned in the first quarter of 1971, double the rate of 1970.

Industry and research projects are proving that recycling can be economically sound. We are on the threshold of new ways to process the mountain of waste that blights America and threatens to drown us in the garbage of our affluence.

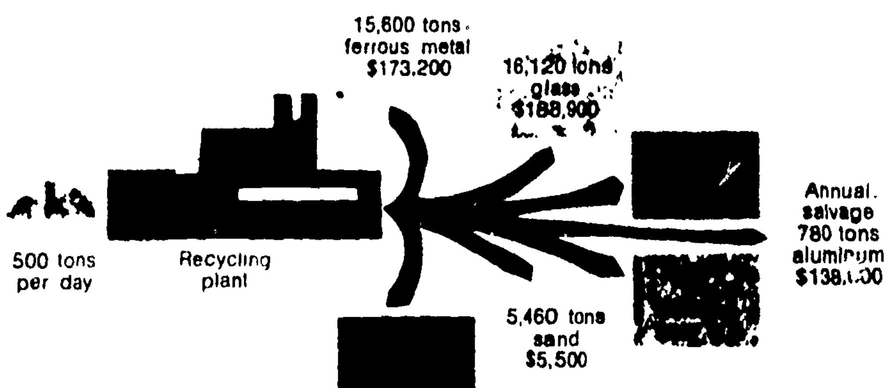
The payoff. Recycling will improve our quality of living, conserve irreplaceable resources. And pay its own way.

MILESTONES

- ***We are awakening to critical need for recycling. Concerned people have turned in billions of bottles and cans.***
- ***Industry has developed plants that take garbage straight from the truck, and reprocess it to save resources. Salvage pays processing cost.***

How to turn garbage into profit

Today's technology can separate and process garbage into reusable resources. Plant in a city of 200,000 could make $100,000 profit.

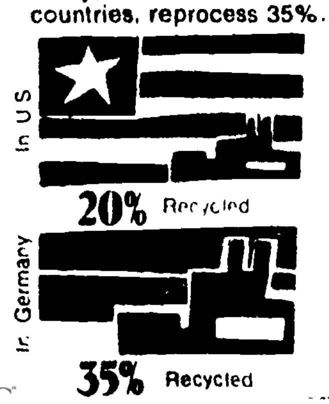


Wastes build roads

Research shows ground-up bottles can replace gravel in asphalt highways. Ground-up rubber tires mixed with asphalt make a crack-resistant road that lasts 4 times longer than conventional roads.

Reuse more paper

U.S. now reuses 20% of 60 million tons of paper produced annually. Germany, other tree-short countries, reprocess 35%.

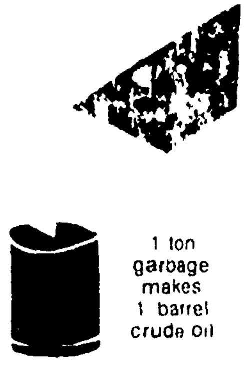


Scrap is valuable

Aluminum cans are worth $200 a ton as salvage.

Oil from garbage

High-pressure steam can convert organic wastes and paper into product resembling crude oil.



Junk cars make new steel

U.S. junks 7 million cars annually. U.S. Steel production now contains 55% scrap.

17. RECYCLE FATS -- MAKE YOUR OWN SOAP

Fats are a by-product, not a waste product, of the meat industry. They are used, along with other fats and oils, to make soap.

In our highly technological civilization, food, clothing, shelter, and even education, recreation, and cultural facilities are provided more in terms of social rather than individual production. In other words, families are no longer self-sufficient units. Instead, people must depend upon one another. This is what we call specialization or division of labor. Each of us does one job, and usually spends full time at it.

This way of life is efficient and therefore desirable because it has made possible our high standard of living. But at the same time it is unfortunate that it tends to lead us away from the world of nature and from the simpler ways of doing things which were part of the everyday life of our forefathers. Perhaps the currently popular "do-it-yourself" movement is, in part, a reflection of the desire to maintain some cultural continuity with that previous era when people routinely and, as a matter of course, "did it themselves."

"What has all this got to do with soap?" you may wonder. Well, soapmaking, you see, used to be one of those "do-it-yourself" jobs. There was just no place to buy soap. So, people had to make it themselves if they wanted it Nowadays, though, few of us even know how it's done. But it's a simple process that can be lots of fun, especially for youngsters.

Save your kitchen grease and fats from meat trimmings and other sources. Vegetable oils can be added to them. Tallow, which is beef and mutton or sheep fat, and lard, which is the fat from pork and bacon, make the best kind of soap. Therefore, it is advisable to mix poultry fats and vegetable oils with lard and tallow rather than use them alone. First, you must clean the fat by boiling one part fat in one or two parts of water. When it is boiling, stir for a while and then strain the upper layer of fat through two or three thicknesses of cheesecloth to remove suspended particles.

After this is done, dissolve a thirteen ounce can of ordinary household lye (which can be purchased at almost any grocery or hardware store) in two and a half pints of cold water. If you are in a hard water area, use rain water so as to avoid the calcium and magnesium which make water hard. These minerals will prevent you from getting a good product. The lye should be added slowly, a little at a time, while you stir the water with a wooden stick. Use an enamel pot or an iron container, because lye corrodes aluminum. Be careful not to get any onto your clothes, skin, or eyes. (If you accidentally do, neutralize it with diluted vinegar and then wash with water.) Once lye is completely dissolved, allow the solution to cool to room temperature.

Now you're ready to actually make the soap. Melt six pounds of your clean fat. This is equivalent to thirteen cupfuls. Get it to a temperature where it just feels warm to the skin on the back of your hand. This should also be done in an enamel pot or an iron container. Then,

Taken from, "TEACHING SCIENCE WITH GARAGE", by Albert Schatz and Vivian Schatz, pp. 42-44

Children can take part in the process of soap making—and they really enjoy it. A constructive task like this helps teach the value of recycling.

stir the fat with a wooden stick (you can use the same one with which you made up the lye solution) while you pour in the lye. Do this mixing very slowly. Pour a little and stir, then wait before adding more lye. This step is very important. It should take at least ten and preferably twenty minutes. Be sure to pour the lye into the fat, and not the other way around.

Continue your slow stirring for another thirty minutes or an hour. At this stage, let the kids come in and lend a helping hand with the stirring so they

Taken from, "TEACHING SCIENCE WITH GARBAGE", by Albert Schatz and Vivian Schatz, pp. 42-44

can participate in "Operation: soap-making." During this additional stirring period after all the lye solution has been added, the soap mixture will gradually become thicker and more viscous When it reaches this condition, it is ready to be poured into molds where it can set and solidify Cardboard boxes or cigar boxes are usually suitable for this purpose. After you have filled these molds with your soap slurry, set them in a warm place without moving for about one week. When they have hardened, you can peel away the cardboard and cut your soap into cakes of convenient size

Now you've "done it yourself." This is what people used to have to do if they wanted soap. There were no supermarkets in those days. They "did it themselves" just as you've done it

For those who are chemically-minded, the following information may be of interest. Fats belong to the group of organic compounds known as esters. Each fat consists of glycerine, which is a kind of alcohol, plus so-called fatty acids. A fatty acid is an organic acid and is quite different from a fat, which is an ester. Lye is sodium hydroxide, otherwise known as caustic alkali. That's why you must handle lye carefully to prevent spilling, splashing, and spattering. Therefore, when you make soap, don't let the children mix the lye, but have them enter the picture only at the final stirring stage.

When you combine the lye and fat, a chemical reaction occurs. This reaction has the technical name of saponification. What happens is that the lye separates the fat into its two components, glycerine and the fatty acids. The sodium in the lye then combines with the fatty acids to form sodium salts of these fatty acids. These sodium salts are what you want. They are the soap.

Now, how does hard water interfere? Well, hard water contains a lot of calcium and magnesium. And when these minerals are present, they form calcium and magnesium salts of the fatty acids instead of sodium salts You see, the sodium salts (or sodium soap) is soluble and so forms good suds. But calcium and magnesium soaps are insoluble, and therefore do not form suds. To sum it all up, soap-making is nothing more than a process for converting insoluble fats into water-soluble detergents. We use lye because it accomplishes just this.

Taken from, "TEACHING SCIENCE WITH GARBAGE", by Albert Schatz and Vivian Schatz, pp. 42-44

CONCEPT VIII

The consumer is a major determiner of the types of materials used in packaging.

BEHAVIORAL OBJECTIVE #8

60% of the students will choose one product from a list of five like products and explain in a list of three reasons why the majority of the students in the class would purchase that product.

TEACHER BACKGROUND

"Modern packages are designed to contain and protect the form and quality of a product and to facilitate its timely and efficient movement through trade channels. And, let it be added in the same breath, to attract and please customers."[1] In writing concept 8, we feel that the consumer does play an important role in determining the types of materials used in packaging because it is he that has to be persuaded to purchase the product. If the consumer is not attracted by the product or the package that contains the product, it is likely that the consumer will pass it by. Industries have to keep the wishes and likes of consumer foremost in mind. Therefore, "to utility have been added color, art, design, imagination, and convenience. Plain bottles have become attractive decanters. Boxes that contain pancake and biscuit flour carry recipes. Cheese comes in gay tumblers. Bags that protect carrots can be put to a dozen uses in a kitchen. Tins for cake and candy are almost like jewel boxes. But with all that, the packages have to be cheap enough to permit a commercially feasible method of distribution, and they have to provide some benefits to growers, distributors and users of the product."[2]

"A processor considers a number of factors in selecting materials and types of containers. Generally, he tries to select a package that most economically meets such basic requirements as protection and preservation of quality, convenience, preferred sizes, and attractiveness."[3] All of these characteristics relate directly to the consumer and to his preferences.

Using all characteristics mentioned, the processor and packager work together to create a packaged product that meets all needs. "For example, not long ago all red meats

were packaged for the customer after she had made her selection from the meat counter. But, in order to adapt red meats to self-service merchandising, the meat had to be cut, weighed, and wrapped in some type of package before being placed on retail display--a development commonly referred to as prepackaging. We like to see the particular cut of meat that we buy, not generally feasible until the development of satisfactory transparent films. Visibility was important, but other packaging problems also arose because of the characteristic of red meat. It generally is bright red immediately upon being cut and becomes dark red soon after being exposed to the oxygen in the air. The extent of the oxidation process and subsequent darkening of the meat, after a long period of exposure to the air, is related to the amount of oxygen to which the meat is exposed. A special type of cellophane had to be developed which would permit enough -- but not too much -- oxygen to penetrate the package."[4] In this example, it is evident that much cooperative thinking must be done to accomplish the task of producing a product that is attractive, convenient, and maintains good quality for the customer.

Shapes and sizes of the packages must also be acceptable to the consumer and often this is a matter of trial and error by the packager. "For example, in a test period of 3 weeks, consumers in three cities showed a preference for apples in 3 or 4 pound bags over similar apples in 5 pound bags. The design of the package is important as well - square milk bottles require one-third less space than round bottles. Short ketchup bottles tip over less easily than tall bottles. A package should not fall apart on the way home. It has to be easy to open. Potato packagers have found out that the customer does not want to unfasten the wire tie with a pair of pliers. Consumers complain when they cannot close a cellophane bag after using part of the contents."[5] All these points illustrate how the consumer must be considered when designing all packages.

1. United States Department of Agriculture, Marketing-the Yearbook of Agriculture-1954, Washington United States Government Printing Office, page 132.

2. Ibid. p. 132
3. Ibid. p. 135
4. Ibid. p. 133
5. Ibid. p. 134

The average family spends at least $200 of its yearly budget just for the package, which is eventually thrown away. In the first activity, the students will bring from home a package (probably a grocery product) which is recyclable and one that is non-recyclable. The activity will demonstrate the kinds of materials used in packaging and point out which ones are recyclable and which are not. Hopefully, this will make the student more aware of the materials that packages are composed of.

The types of packaging that are recyclable include the following: glass, metal cans, paper packages, cardboard. All of these can be returned to recycling centers and can be processed to be used again.

The following list is of packaging that cannot be recycled. They are: plastics, plastic products such as styrofoam, and cellophane.

Plastic coated paper packages can be recycled if the plastic is removed; however, the process is too expensive so that they are not recycled.

The second part of activity one is to discuss characteristics of packages:

1. The aesthetics of the package (attractiveness, good lines, display of the product)

2. Ecological soundness (biodegradable, use of minimum resources to produce wasting of resources

3. Appropriate packaging for the product (protect and preserve the quality of the product, preferred sizes, convenience)

4. Advertisement (psychology of packaging: is it advertised honestly? does it make the product appealing to all?)

After discussing the characteristics of the packages, it is important that the students begin to see that it is the consumer who the packagers are appealing to.

Activity 2 follows the foremat of activity 1. Following activity 2, the student will make a list of demands that he as a consumer will make on the packaging industry. An example is: People demand that the product be packaged so that the quality is preserved.

The final activity is a short term but very involved activity. This will allow the students to think in terms of the consumers demands and will allow him to create his own package and his own way of advertising it. You as a teacher should make your own guidelines for the project.

ACTIVITIES - CONCEPT VIII.

1. All students are to bring to school one packaging material which is recyclable and one that is not recyclable. This is to illustrate the various kinds of packaging materials. Following the presentation of all types of packaging materials, the students should discuss the characteristics of the packages and the feasibility of each. The characteristics that you might consider are: 1. aesthetics, 2. ecological soundness, 3. appropriate packaging for the product, 4. advertisement (psychology of packaging). Relate all these characteristics to the consumer and his needs.

2. Following activity 1, the teacher will place 5 packaging materials on the desk and ask the students working in small groups to analyze the packaging material in terms of: 1. aesthetics, 2. ecological soundness, 3. appropriate packaging, 4. advertisement

   After the completion of this activity, the students will make a list of the demands that the consumer makes on the packaging industry.

3. Following activity 2, the teacher should choose a product and secure 4 or 5 packages that contain the product. For example, choose a product such as green beans and bring to class green beans in a can, in a jar, in frozen paper packages, frozen in a plastic bag, etc. Display the packages where all can see them well. Ask the students to chose a package which they think the majority of the class would purchase. Tell them to base their answer on the packaging type. Also, ask them why they chose the package.

4. There are many speakers who would be happy to talk to students on the subject of packaging and advertising-particularly people in the packaging industry.

*1. Don Heim--Rexham Corporation

*2. Richard A. Mattson--Alton Box Board

*3. Ralston Purina may have a speaker

4. Contact any advertising agency

*Phone numbers are listed in the back under Resource People.

5. A culminating activity on this topic of packaging materials is for the students to divide into small groups and choose a product which the students would like to work with. The students will design the packaging materials which suits all aspects of correct packaging keeping in mind the ecological soundness of the package. They will make their package and then develop an advertising campaign for their product. They might decide to make a commercial to sell their product. This activity should allow for creativity by the students.

CONCEPT IX

Synthetic materials (non-biodegradable) are often used in packaging for economic reasons.

BEHAVIORAL OBJECTIVE #9

70% of the students will be able to choose the least expensive item from each of 3 pairs of items based on packaging material used.

TEACHER BACKGROUND

In this concept we hope to show that synthetic materials are more often used as packaging materials and why. First, the student should be able to list at least five different packaging materials and, secondly, he should be able to substantiate why the packager used that material (i.e. the size of the product, its content, whether it will spoil or not, and other various peculiar characteristics that it might have).

First, and foremost, in the mind of the packager is the cost of the material. Perhaps the least expensive for him to use is plastic, or a type of plastic, such as styrofoam or cellophane. These are very inexpensive as far as the packager is concerned. He does not have to worry about collection as it pertains to returnable bottles. But to the environment these materials are very costly. The plastics are non-biodegradable and take centuries to return to their natural elements.

But the average consumer is more interested in the cost of the product, not what it is packaged in. Our society is known as the "throw away society", and no matter what material is used it will be tossed into the trash. Therefore, the teacher should stress the fact that in the long run, if the consumer stops purchasing products in non-biodegradable packages, this will force the packager to stop using these "environmental killers".

CONCEPT IX - ACTIVITIES

1. Have a speaker on the economy of packaging material as brown bags, cellophane, ties, tape, etc. contact a local grocer.

2. An important activity is a field trip to a grocery store to examine how products are packaged differently and how the price is raised or lowered according to the type of packaging. Each student should pick a feasible product which can be packaged in different packaging material and answer the following questions about the product.

    a. What is your product?

    b. List the various methods of selling your product (i.e. frozen, fresh, canned, etc.)

    c. List all the various kinds of packaging materials that your product can be found in.

    d. List the various sizes in which the product can be purchased. (i.e. 1 lb. can, 2 lb. can)

e. What companies sell the product?

f. Figure out the cost of the product per weight in each package. (1 lb. can tomatoes - 29¢ per lb.)

    1. Which product is the cheapest in a nonrecyclable packaging material?

    2. In a recyclable package?

    3. Of the two, which is the cheapest?

    4. Explain why for No. f-3.

g. Which of the packages examined would be better for the environment? Explain why.

h. In which product do you suppose the greatest amount of money was spent in the packaging process? Why?

i. How do you feel the packaging industry could help the environment?

CONCEPT X.

There are many careers related to recycling

BEHAVIORAL OBJECTIVE #10

95% of the students will be able to name two jobs related to recycling for each of the following three areas: skilled, semi-skilled, and unskilled.

TEACHER BACKGROUND

Examples of careers related to recycling are as follows:

I. Skilled - this includes careers in which the individual needs a college degree or its equivalent.

A. Advertising
B. Packaging design
C. Marketing
D. Microbiologist
E. Chemist
F. Engineer

II. Semi-skilled - Requires natural skills and a lot of on the job experience.

A. Operators of heavy equipment
B. Lab-technicians
C. Landfill supervisors

III. Unskilled - Jobs that can be carried out with little skill or experience.

A. Garbage Collector
B. Truck Drivers

CONCEPT X. - Activity

There are many careers related to recycling.

1. Invite the guidance counselor to discuss careers in recycling.

2. Discuss careers in the unskilled, semi-skilled, and skilled jobs in fields related to recycling.

unskilled - garbage collector, landfill operator, truck driver

semi-skilled - laboratory technician, grocer, bulldozer operator (landfill)

skilled - engineer, urban planning, advertiser, microbiologist, package designer, consumer analysist, market researcher, writer

Teacher should give the Pre-Post Test again now that the activities are complete and fill out the student evaluation sheet on the following page (to be returned by interschool mail to EEE Staff, Central Office).

TEACHER REPORT FORM

School________________________

Teacher_______________________

Unit__________________________

When Completed Return To:

Verlin M. Abbott
Administration Building

Student post-test results will be grouped in the following manner:

Example:

Number of post-test questions given 15 .

Number of students	Number of questions answered correctly.
6	12
5	10
8	9

Number of post-test questions given.____		Number of post-test questions given.____	
Number of Students	Number of Questions Answered Correctly	Number of Students	Number of Questions Answered Correctly

TEACHER - STUDENT BIBLIOGRAPHY

Bell, Dr. Garrett, The Environment Handbook, Ballantine Books, Inc., New York, 1970.

Foster, Allen, Advertising, Criterion Books, New York, 1967.

Glatzer, Robert, The New Advertising, The Citadel Press, New York, 1970.

Godfrey, Arthur, The Arthur Godfrey Environmental Reader, Ballantine Books, New York, 1970.

Goldman, Marshall I., Controlling Pollution, Prentice-Hall, Inc., Englewood Cliffs, 1967.

*Goldstein, Jerome, Garbage As You Like It, Rodale Press Inc., Emmaus, 1971.

Hunter, Beatrice Trum, Consumer Beware, Simon and Schuster, New York, 1971.

*National Wildlife Federation, 1971 E. Q. Index, National Wildlife Federation, Washington, D. C. 1971.

*Olympus Research Corp., Career Education in the Environment, U.S. Government Printing Office, Washington, D. C.

Osborn, Fairfield, Our Crowded Planet, Doubleday and Company, Inc., Garden City, 1962.

Pringle, Laurence, The Only Earth We Have, The Macmillan Company., New York, 1969.

Rienou, Robert, Moment in the Sun, The Dial Press, New York, 1967

*Rodale, Robert, The Basic Book of Organic Gardening, Ballentine Books, New York, 1971

Saltonstall, Richard, Your Environment and What You Can Do About It, Walker and Company, New York, 1970.

*Schatz, Albert, Teaching Science with Garbage, Rodale Press, Inc. Emmaus, 1971.

Schlitt, Dorothy, Life: A Question of Survival, Pawnee Publishing Company, Inc., Boulder, 1972.

*U. S. Environmental Protection Agency, California Solid Waste Management Study 1968 and Plan 1970, Solid Waste Management Office, Washington, D. C. 1971.

MAGAZINES AND PAMPHLETS

Better Homes and Gardens, Garbage Pollution: What You Can Do To Help, October, 1972.

Business Week, Garbage Gets A Glamour Image, March 4, 1972, p. 44.

Business Week, Incinerator Yield a Lode of Glass, March 11, 1972, p. 60.

Business Week, Plastic Makers Try to Cut The Litter, April 3, 1972, p. 99.

Environment, Sheldon Novick (editor), The Environment 438 North Skinker Blvd., St. Louis, Missouri, 1971.

Newsweek, Packaging: And Tie It With a Ribbon, May 1, 1972, p. 100.

Resource Recovery Act of 1969, Part 3-5, U. S. Government Printing Office, Washington, D. C., 1970.

Rodales Environmental Action Bulletin, 33 East Minor Street, Emmaus, 1971-1972.

Time, Recycling Garbage, April 3, 1972, p.99.

What Are We Doing About Our Environment, William Houseman, Environment '71, Advertisement, P. O. Box 5905, Grand Central Station, New York, New York 10017

AVAILABLE PAMPHLETS ON RECYCLING

The following can be acquired without charge from the Glass Containers Manufacturing Institute, Inc., 330 Madison Avenue, New York, New York 10017.

1. The Solid Waste Fact Book

2. The Litter Fact Book

3. Solid Waste Management and Litter Control

Returnables Vs. Nonreturnables, 1971. by the Chamber of Commerce of the United States of America.

National Center for Resource Recovery, Inc., Suite 800, 1211 Connecticut Avenue, N. W., Washington, D. C. 20036

Let's All Pitch In, United States Brewers Associations, Inc., 1750 K Street, N. W., Washington, D. C. 20006

Litter and Solid Waste: Solvable Problems, Ecology Department, Anheuser-Busch, Inc., 721 Pestalozzi Street, St. Louis, Missouri, 63118.

FILMS AVAILABLE ON RECYCLING

Films from County Library:

1. The Garbage Explosion The problem: a rapidly growing economy is producing rapid environmental pollution; vast increase in waste materials. Film explores the nature, volume and composition of garbage, current disposal methods and possible long-range solutions.

2. A Land Betrayed America is a land of beauty, but scarred by ugliness. Man has worked to preserve beautiful areas but has desecrated them by litter, vandalism, etc. Stresses the importance of the individual's role in keeping America beautiful.

3. The End of One The seagulls scavenge for food from a huge garbage dump. Nearby, a lone, frail gull limps along a polluted stretch of beach, stumbling, dying. His fellows continue their raucous competition, uncaring. Suggests a death-knell for our environment. An allegory on greed.

4. Conservation: A Job For Young America This delves into the problem of litter, and the disregard for the beauty of nature. The need for greater conservation efforts and what can be done to meet this need must be demonstrated by young Americans.

Films available through the United States Brewers Association. Call Richard Gergs 421-5325

5. "Things Worth Saving" This film shows what man's technology is doing to solve the solid waste disposal problem. One example, is the pneumatic disposal system in a subdivision in Disney World.

6. "Litter and Solid Waste - An Objective View" This film is narrated by Paul Burke and is somewhat slanted by the beer industry. But it does point out some interesting facts concerning littering and solid waste disposal.

RESOURCE PEOPLE

Name	Business	Phone	Concept No. and Subject Covered
1. Edward R. Shelly	Alton Box Board	227-1100	Concept 7 Recycling
2. Richard Gergs	United States Brewers Assoc.	421-5325	Concept 3 Pitch-In
3. Richard A. Mattson	Alton Box Board	463-6106	Concept 8 Advertising
4. Don Heim	Reham Corp.	423-8186	Concept 8 Advertising
5. Bill Miller	St. Louis County Landfill	739-7590	Concept 7 Landfill
6. John Schneider	St. Louis County Health	726-1100	Concept 7 Landfill
7. Joe Seibert	Home	Ca7-1686	Concept 6 Composting
8. Staff	Alcoa	863-0300	Concept 7 Recycling
9. Staff	Ralston Purina	982-0111	Concept 8 Advertising
10. Staff	Owens' Illinois Plastic Products or Glass Division	863-0840	Concept 6 Recycling

GLOSSARY

1.	Biodegradable	The breaking down of materials biologically; decaying or decomposing.
2.	Composting	A method of taking garbage or organic matter and letting it decay and return to the basic elements.
3.	Consume	To do away with completely, to use up.
4.	Consumer	One that utilizes economic goods
5.	Decay	To undergo decomposition, aerobatic decomposition of organic materials, primarily by bacteria.
6.	Ecology	The interrelationships between organisms and their environment.
7.	Environment	The surroundings of an organism, including such factors as the climate, biotic factors, cultural, and social conditions.
8.	Glasphalt	A new type of road pavement that includes a large amount of crushed glass.
9.	Garbage	Food waste.
10.	Organic matter	Material which is living or once living.
11.	Reclamation	To obtain the return of.
12.	Recycling	Resources are to be used over and over again and cycled through human economic-production systems in a way that is analagous to the cycles of elements in nature.
13.	Returnable	Capable of being returned to be re-used again.
14.	Natural Resource	Actual and potential forms of wealth supplied by nature (i.e. mineral deposits and water power).
15.	Salvage	Any item or material that is saved from destruction.
16.	Synthetic	Man-made products not found in nature.
17.	Trash	A convenient overall term in referring to all solid waste that is discarded.

ENVIRONMENTAL RESOURCE INVENTORY

School: Central Junior High

A. Description (Annotation) of Resource

Dierberg's Grocery Store on corner of Olive and Woods Mill is a recycling center for this area. Dierbergs works with the Salvation Army in this project.

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # II

Encourage students to make use of this center- a chart to show and compare donations could be used.

C. Address - (Location) (above)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: Central Junior High

A. Description (Annotation) of Resource

Art Department

B. Education Use Possibilities (Acitivities)

Unit: ~~Trash~~ Grade Level: 7 Concept # III

1. Newspapers may be recycled to construct papier maché sculptures and puppets.
2. Newspapers are also used to cover the desks when working with clay and other messy materials.
3. Newspapers and magazine sheets may be used to make disposable palettes for paint as well as for clay sculptures.
4. Life and Look magazine (made with clay base paper) make good slides and transparencies.
5. Magazines pictures are excellent to use for collages, posters, mobiles, etc.
6. Use both sides of a piece of paper before throwing it away.
7. Keep a scrap box of colored paper (large scraps) to use for paper sculptures, paper masks etc.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: Central Junior High

A. Description (Annotation) of Resource

Green Trails subdivision - variety of nature materials used for building such as stone, flagstone, walks - retaining walls of limestone. Wooden railroad ties as retaining walls.

B. Education Use Possibilities (Acitivities)

Unit: Trash **Grade Level:** 7 **Concept #** III

Students to take inventory of types of building materials man uses that re natural. Possible have students label them functional or aesthetically appealing (or both).

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: Central Junior High

A. Description (Annotation) of Resource

Wooded area on hill to west of school site.
Concrete blocks along main path.

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # V

The concrete is an example of a synthetic material which has been there a long time and has not decomposed. Compare to fallen trees nearly which are in various stages of decomposition.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: Central Junior High

A. Description (Annotation) of Resource

Barriers at edges of bus parking lot - reused railroad ties.

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # II

An example of wood recycling - conservation of trees. In other instances the district has used new lumber for this kind of thing have the students find examples where used materials could have been used instead of new.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: Central Junior High

A. Description (Annotation) of Resource

Art Department

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept #

Have students use these recycling ideas and think of more.

1. Plastic ice cream cartons and better cartons are used to hold water, tempera paints, wheat paste, brushes, etc.
2. Shoe boxes are used to hold art materials
3. Cartons and boxes are used as foundation for certain art projects.
4. Scraps of material and trim are used for puppet clothes or collage.
5. Wallpaper scraps and samples are used in design and collage.
6. Scraps and pieces of wrapping paper including foils are used in designs and collage.
7. Gerber baby food bottles are good water, paint and glaze jars.
8. Plastic tempera, finger paint and glaze jars are good reused for water, paint and glaze jars.
9. Scraps of wood and paneling are good to mount copper on and for small craft projects.
10. Plastic bottles and cartons may also be used as the foundations of some art projects.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: Central Junior High

A. Description (Annotation) of Resource

Don Kreisman science teacher at Central Junior High has Masters' degree in Environmental Education and is a good resource person

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # II and III

Don suggested students take a walk from Central Junior to Central Senior and pick up all cans and letter accumulated.

He also suggested we note all the oil from automobiles on the roads and parking lots adjoining Central Junior and Central Senior

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: Central Junior and Senior High

A. Description (Annotation) of Resource

Area of second growth timber located north of Central Junior High extending east west approximately 1/2 mile depth to creek running east west approximately 300 feet.

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # I

Note decomposition of wood, humus and its enrichment of the soil - trees broken by wind etc. fall - animals burrow into, decay, etc. - Man-made materials which were not decomposing - concrete, steel, cans, cellophane, plastic.

Have students gather materials from grounds to test biodegradability in classroom.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: East Junior High

A. Description (Annotation) of Resource

60 acre farm adjacent to Parkway East Junior and behind the subdivision on Parkway's North side. Farm owned by Mr. Roy Lindner - He has lived here since 1850's is trying to sell now.

B. Education Use Possibilities (Acitivities)

Unit: ~~Trash~~ Grade Level: 7th Concept # II

Good source for possible interview by teacher - Possibly willing to talk to class.

Lindner is total farmer - cattle
crops
chickens
fruit

Family has lived in area since 1850 -
He is one of 5 children -
Sister teaches at Weber Elementary

C. Address - (Location) 12000 Hibler Road

Personnel in Charge (If pertinent) Farm adjacents Parkway East Junior

Telephone

Use Limitation, Hours, Etc. Must talk with owner in person to ask permission

ENVIRONMENTAL RESOURCE INVENTORY

School: East Junior High

A. Description (Annotation) of Resource

Concrete storm sewer. From Ballas to Lake (south of Ladue Road about 300 years)

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # I

The storm sewer is eroding away and breaking up. Have students find other examples of the "man vs. nature" theme to photograph, sketch, or write a poem or limerick about.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: North Junior High

A. Description (Annotation) of Resource

St. Louis County land fill on Adie Road
adjacent to Alton Brick Company

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # III

The Alton Brick works dug out all the clay surrounding it's facility for making bricks. The resultant crater was an excellent example of the result of strip mining. This area is now being used as a sanitary land fill. Only biodegradable materials are allowed in and this trash is compacted by tractors or trucks and then covered daily with 4-6 inches of dirt. Upon completion the site will be usable for recreational facilities, housing, or light industry. The fill is described as "sanitary" since the gases created by the decomposing organic materials kills rats and undesirable rodents. The dirt covering daily keeps the operation all but odorless.

C. Address - (Location)

Personnel in Charge (If pertinent) Mr. Schmidt
Health Department

Telephone 739-7590

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: North Junior High

A. Description (Annotation) of Resource

School store

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # VII

A committee or small group may check the materials which are put in the trash can and picked up by the maintenance men for disposal (cardboard containers, boxes, etc.)

The students may then bring the list back to the class and discuss how these items may be reused for class products and activities.

-example - cardboards boxes may be used for art projects, etc. to be displayed in the classroom, halls, etc.

Various classes may compete as to the number of variety of uses of these non-biodegradable materials.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: North Junior High

A. Description (Annotation) of Resource

School kitchen

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # III

Discuss items that are returned for reuse in the school cafeteria. Also how many items are purchased in non-returnable containers?

Have the class (probably small groups) analyze (through survey) what types of items and in what quantity they are purchased. Determine if more articles could be reused.

This activity could be continued with a study of home products and possible comparisons made.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: North Junior High

A. Description (Annotation) of Resource

School Cafeteria

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # VIII

Discuss how the consumer (students, parents, etc.) determine the materials used in packaging.

The students could itemize how food distributed by the cafeteria is packaged - milk in cartons, plate lunches on paper plates, plastic knives, etc.

After the list is made, the students may determine the number of these items used by the school for a week or longer.

Then they may want to anlayze why the type of packaging is used - time factor, easier distribution, economy, etc.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: North Junior High

A. Description (Annotation) of Resource

School building (inside)

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # VIII

Each student may list all the items he used or purchased during a school day (this list may continue for a week or more).

-items may have been purchased in cafeteria, school store, or outside the school at various businesses.

-a chart may be utilized to:
1. list the item (pencil, cookies, etc.)
2. type of package (if any)
3. why the manufacturer used the type packaging (consumer approval, etc.)

These list may be discussed in class to discover the part consumers play in types of packaging used by manufacturers.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: North Junior High

A. Description (Annotation) of Resource

Trash cans from classroom

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # VII

To help students differentiate between biodegradable and non-biodegradable trash have a few students sort the trash can's trash into these two categories. Class can make notes of mistakes as they do this on a table in front of class.

NOTE: teacher should "stack the deck" with some questionable items as aluminum can, or baggie, a plastic tie off a baggie, something syrofoam, as well as other things she probably wouldn't have in the cans as a milk carton, orange peal, etc.

Students to discuss afterwards any mistakes or just why aluminum cans are bad for land fill dumps but tin cans aren't, etc.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: North Junior High

A. Description (Annotation) of Resource

I. Pond and wooded area of North Junior High
II. or elsewhere on school grounds

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # I

Have students survey school grounds to determine examples of "recycling in nature". Examples: Decay of logs, stumps, leaves, grasses, and animals. (Nitrogen Cycle) (Oxygen - Carbon Cycle)

Students should describe in writing the examples they find.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: North Junior High

A. Description (Annotation) of Resource

Selected areas of school ground

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # IV and V

Have students list the types of biodegradable and non-biodegradable products found on the school grounds. After listing the non-biodegradable products, students should determine if these materials are natural or man-made litter. (Also if any of these materials can now be recycled).

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: North Junior High

A. **Description (Annotation) of Resource**

West side (relatively barren) compared with East side (wooded).
Landscaping vs. Erosion

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # X

The students will survey the area and do a map showing errain, gullies, plants and bare land. Then hypothesize what was not considered when the land was developed for use by man. This exercise would lend itself will to photograph studies.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: North Junior High

A. Description (Annotation) of Resource

Creve Coeur Park

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # II

The St. Louis County Parks Department through a federal grant is acquiring all dwellings in the lake area for an increased park facilities. The students could inquire on how these dwellings will be disposed of and possible reuse or hypothesize on what the Park Department is going to do with these homes and buildings (recycle or destroy).

C. Address - (Location) Creve Coeur Lake front

Personnel in Charge (If pertinent) Mr. James Sutton

Telephone

Use Limitation, Hours, Etc.

see Pat Keebey for further information

ENVIRONMENTAL RESOURCE INVENTORY

School: South Junior High

A. Description (Annotation) of Resource

The teacher workroom (at any building)

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # II

Keep tabs on the amount of duplicator paper used by the teaching staff over a given period of time.

-Check the waste cans to see how much is immediately discarded.

-Suggest ways of conserving paper at school

-Alternatives to duplicating on paper.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: South Junior High

A. Description (Annotation) of Resource

Cafeteria

B. Education Use Possibilities (Acitivities)

Unit: ~~Trash~~ Grade Level: 7 Concept # V

Cafeteria uses styrafoam plates, plastic utensils, both of which are non-biodegradable. Survey the amount of both which is used each day, week, etc. Find out the cost envolved as compared to using biodegradable materials. Locate the places where the materials are discarded or find out how they are disposed of.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: South Junior High

A. Description (Annotation) of Resource

Ground cover which is being composted naturally - located in woods surrounding the cemetery west of South Junior High

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # I

This is an example of one method that recycling occurs in nature independent of man.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: West Junior High

A. Description (Annotation) of Resource

Woods on west side of Baxter Road between Clayton Road and West Junior

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # II

There is a woods with many older trees and some on the ground. Investigate the logs in their rotting process. There are bird nests, ant hills, etc.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.

ENVIRONMENTAL RESOURCE INVENTORY

School: West Junior High

A. Description (Annotation) of Resource

Standard Gas Station on the southwest corner of Baxter and Clayton Roads.

B. Education Use Possibilities (Acitivities)

Unit: Trash Grade Level: 7 Concept # III

They collect the cans they use and have then recycled. Students could interview these people to find out how it is done and try to spread the word to other filling stations.

C. Address - (Location)

Personnel in Charge (If pertinent)

Telephone

Use Limitation, Hours, Etc.