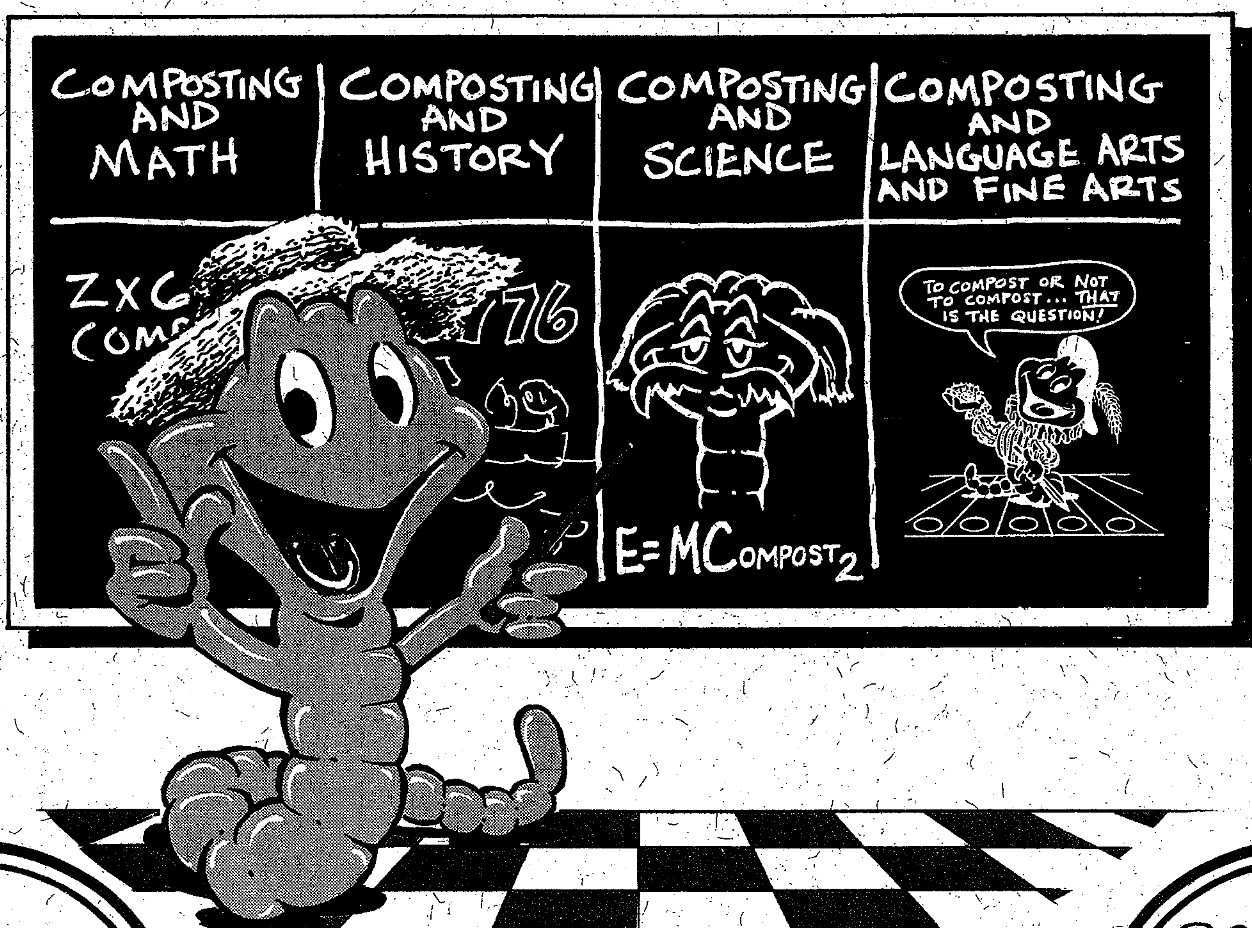
COMPOSTING ACROSS THE CURRICULUM

A TEACHER'S GUIDE TO COMPOSTING



MARIN COUNTY OFFICE OF WASTE MANAGEMENT
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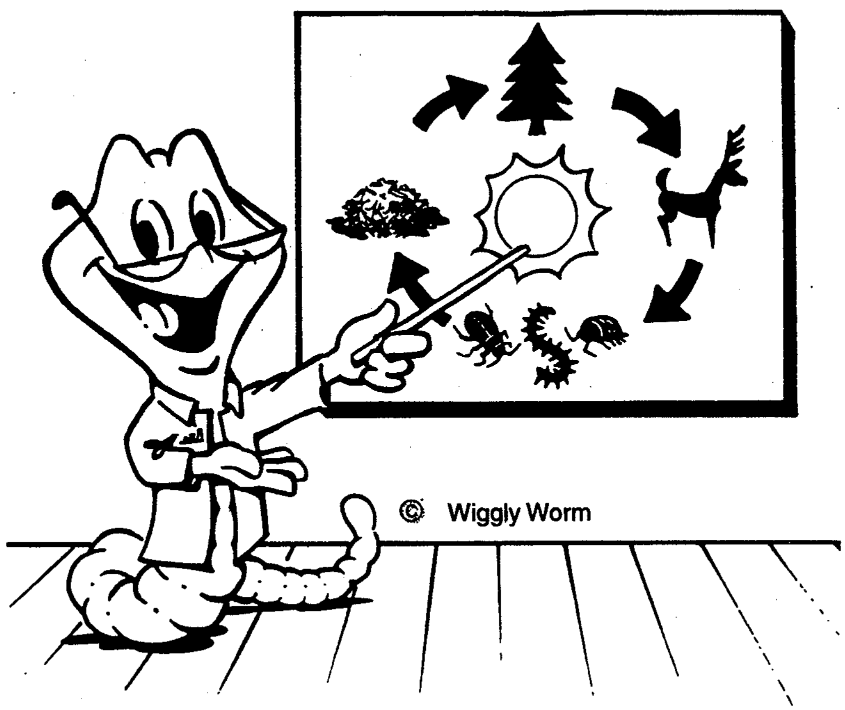
Composting across the Curriculum

A Teacher's Guide to Composting



MARIN COUNTY HAZARDOUS AND SOLID WASTE
MANAGEMENT AUTHORITY, OFFICE OF WASTE MANAGEMENT

(415) 499-6647

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INTRODUCTION

Few things are more basic than food. Our food supply and ability to grow food is intimately connected with the nutrient cycle of this planet. The water cycle, air cycle, rock cycle and other cycles interface with the nutrient cycle and all effect each other. These cycles and processes literally run our planet. All of us depend upon them for survival. Composting is a way of showing respect to the earth by working in harmony with natural processes. For the imaginative and astute, composting can be connected to almost everything we do.

The intent of this curriculum guide is to:

1. Give teachers the technical information to feel comfortable starting a compost project with their class.

2. Spark ideas which will help teachers connect composting into other subject areas.

3. Provide teachers with lessons and activities on composting, solid waste, and nutrient cycling that encompass many existing curriculum requirements.

4. Foster respect for the earth through knowledge and responsible action regarding our treatment of resources which we now label, "waste".

With some forethought and planning, composting can be used to help teach other subjects already required in schools. It need not be an added burden in an already overcrowded day. Classroom composting provides a perfect opportunity to apply skills and knowledge from many subject areas. Connecting composting into social studies, language arts, math, science, fine arts, music, and physical education will help build composting into the school day and will show students how truly connected natural processes and human endeavors are.

This guide contains a section with ideas for integrating composting into your curriculum. Where possible, these ideas are referenced to one of the California State Curriculum Frameworks. Several examples of activities illustrating a concept may also be listed. These examples are just to get started; there are many other activities that also illustrate particular concepts.

HOW TO USE THIS GUIDE

This guide is organized into two parts each containing several sections. Part One contains information for teachers delineating the reasons and advantages of including composting in a school curriculum, with complete instructions on starting and maintaining backyard and worm composts. Part Two contains 21 activities and several full page graphics focusing on compost, soil, decomposition, waste management and compost education.

PART ONE: TEACHER BACKGROUND

Section One - ***Why Compost?:*** Explains the importance of decomposition and nutrient cycling in our daily lives, what is composting and our national waste management crisis.

Section Two - ***Connecting Composting Into Your Curriculum:*** Pulls relevant principles and concepts from the California Department of Education State Frameworks in science, social science, language arts and mathematics. For each framework, relevant concepts are listed by grade level and theme. Suggestions for incorporating a concept into a compost project are given along with suggested sample activities.

Section Three - ***How To Compost:*** Gives complete instructions for the novice composter to start and maintain both a backyard and a worm compost. Instructions include how and why composting works, the optimal conditions for compost organisms, materials needed, how to use finished compost and a troubleshooting guide.

PART TWO: ACTIVITIES

Section One - ***Soil And Decomposition:*** Contains decomposition experiments, soil studies, active compost games, worm box explorations and activities which trace our food back to its source.

Section Two - ***What Is Waste?:*** Explores our present state of waste generation and disposal. Activities include trash audits, using math to calculate waste statistics, sorting and classifying garbage, a simulated town meeting and community projects where students take an active role in teaching others to compost.

GLOSSARY: Defining terms used in composting.

APPENDIX A - **Resource Guide:** Lists books, curricula, where to get compost supplies, journals, magazines, newsletters, resources for kids, videos and slides.

APPENDIX B - **Compost Bin Designs:** Five bin designs and construction instructions are provided for those wanting to build their own compost bins.

This Compost

Behold this compost! behold it well!
Perhaps every mite has once formed part of a sick person
- yet behold!

The grass of Spring covers the prairies,
The beans bursts noiselessly through the mould in the garden,
The delicate spear of the onion pierces upward,
The apple-buds cluster together on the apple-branches,
The resurrection of the wheat appears with pale visage
out of its graves.

What chemistry!
That the winds are not really infectious,
That all is clean, forever and forever,

That the cool drink from the spring tastes so good,
That blackberries are so flavorous and juicy,

That the fruits of the apple-orchard and the orange-orchard,
that melons, grapes, peaches, plums, will none of them poison me,

That when I recline on the grass I do not catch any disease,
Though probably every spear of grass rises out of what was once a
catching disease.

Now I am terrified at the Earth, it is that calm and patient,
It grows such sweet things out of such corruptions,
It turns harmless and stainless on its axis, with such endless
successions of diseased corpses.

It distills such exquisite winds out of such infused fetor,

It gives such divine materials to men, and accepts such leaving
from them at last.

- Walt Whitman

WHY COMPOST?

ORGANIC MATERIAL AND SOIL ORGANISMS

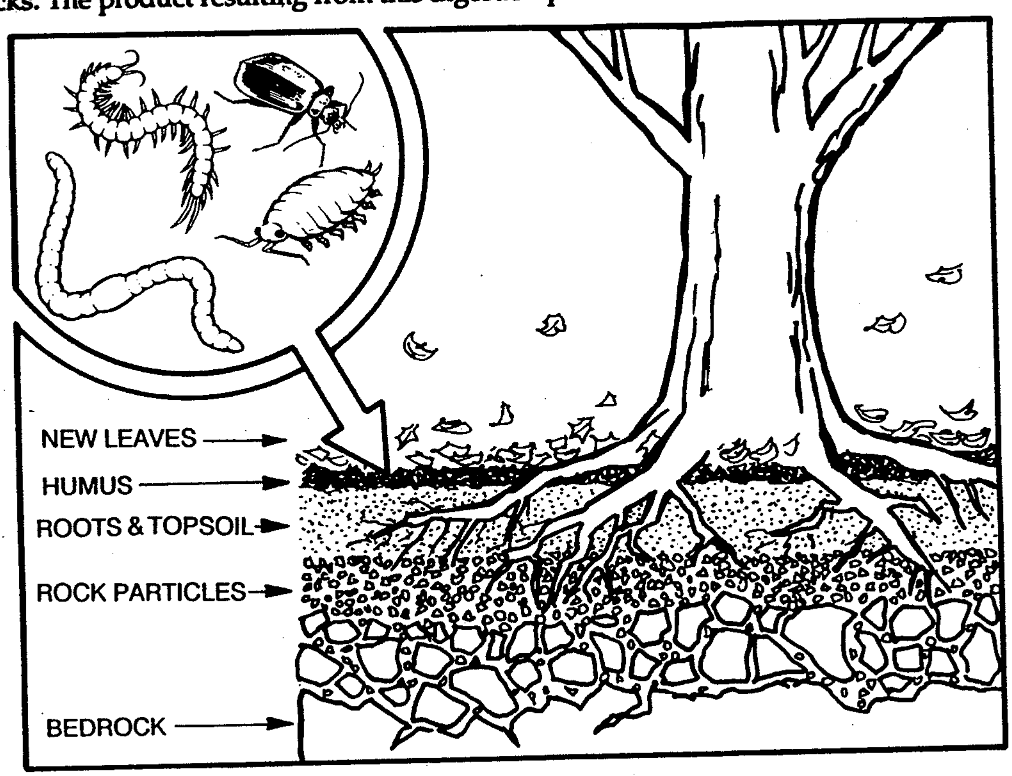
The soil

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

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

Digestion

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



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

Why Compost?

Chemical fertilizers

In nature, plants suck up nutrients and minerals held in humus. On commercial farms people often feed plants chemical fertilizers instead of feeding decomposers organic material which is converted into humus. Although most chemical fertilizers provide the major known nutrients plants need, (nitrogen, phosphorus and potassium) minerals and other nutrients contained in humus are not found in chemical fertilizers.
Nature feeds plants by feeding the soil. Chemical fertilizers feed plants directly but neglect to feed the organisms in the soil. Large quantities of chemical fertilizers can imbalance the soil, harming soil life. Healthy plants need a full range of major and minor nutrients and minerals easily found in humus.

Topsoil

Soils are formed as decomposers digest organic material on the surface into a humus covering called topsoil. Topsoil is the fertile part of the soil, where plants have the nutrients they need to live and grow. Along with providing nutrients and minerals, humus helps soils breathe, hold water and aggregate so plants can root more easily. Topsoil can range from a few millimeters thick to a few meters, depending on the environment and the age of the soil.

Nutrient cycling

In the forest, it is easy to see nutrient cycling happen naturally. Trees drop their leaves and plants and animals die, providing food for decomposers in the soil. Decomposers digest the dead material, producing humus, which contains nutrients and minerals in a form that can be absorbed by plants. The humus formed when people bring the right combination of organic materials together in large quantities is called compost.

Compost can be added to soil, increasing the amount of humus in the topsoil. When organic material is not returned to the soil, decomposers starve, nutrients are not released and plant health declines, resulting in a poor quality of food for humans and animals.

Plant health

Weak plants are susceptible to pest predation and disease. Humans often battle plant pests and diseases with herbicides, fungicides and pesticides. These toxic chemicals not only kill plant pests and diseases but also kill decomposers and other beneficial creatures. As decomposers die there are not sufficient numbers of them to convert organic material into humus and plant health declines even further.

Erosion

When plants die, their roots no longer hold and trap the topsoil. With the plants gone, rain, wind and animals can cause extensive topsoil loss in a very short period of time. A topsoil layer thick enough to support large plants, can take hundreds to thousands of years to develop, depending on the ecosystem.

Soil health

Removing organic material from soils year after year can cause rapid decline and eventual loss of soil fertility, which we all depend on. Returning organic material to the soil by letting it decompose where it falls or through composting, can heal damaged soils and insure continued health for fertile soils.

WASTE MANAGEMENT

There is a national landfill crisis. All across the country people are generating waste at a rate that far exceeds our capacity to dispose of it. More than one-third of our landfills will be full within the next several years. In California, it is estimated that existing landfill space will reach capacity by the year 2000 if we continue to generate waste at our present rate.

Landfills

Many people think organic materials decompose in landfills but studies have found 40 year-old hot dogs and 50 year-old newspapers in landfills. The environmental conditions in landfills usually lack oxygen, are too toxic, and too wet or dry to support a large community of decomposers.

It is hard to site new landfills. Few people want a landfill near their home. Landfills take up valuable space and have potential health risks associated with them, such as the release of gases, the presence of small amounts of hazardous wastes and the potential release of leachate, a liquid that collects in landfills and can drain into the ground water supply.

A.B. 939 - The California Integrated Waste Management Act

Much of what we consider waste, and bury in a landfill can be reused or recycled if properly handled. California law mandates that cities and counties reduce the amount of waste they landfill by 25% by 1995 and by 50% by the year 2000 or they may face fines of $ 10,000 a day.

Why Compost?

Recycling

The first thing most cities and counties do to reduce their waste is to expand their recycling programs. Most people are familiar with recycling glass, metal and paper and in many places some type of recycling program already exist. In Marin County, in 1990, glass was 4%, metal 3%, and paper 29% of the waste generated. If Marin County residents recycled all of their glass, metal and paper, the amount of material being landfilled could be reduced by 36%.

Composting

The next big amount of waste to be diverted from landfills is organic material. Organic material is anything that was once recently living, basically materials that come from plants and animals. In Marin County in 1990, "yard material" was 13% and "other organics", which include agricultural materials, food products, and textile discards, were 29%, for a total amount of organics comprising 42% of the waste stream. Organic materials can be composted reducing the amount of waste disposed of in landfills.

As we saw in the soil fertility section, organic materials come from the Earth and should be returned to the Earth to keep the nutrient cycle going. Composting on both a small and large scale, along with changes in our agricultural and industrial practices, promises to reduce the large amount of organic material presently disposed of in landfills.

USING COMPOSTING TO TEACH SCIENCE

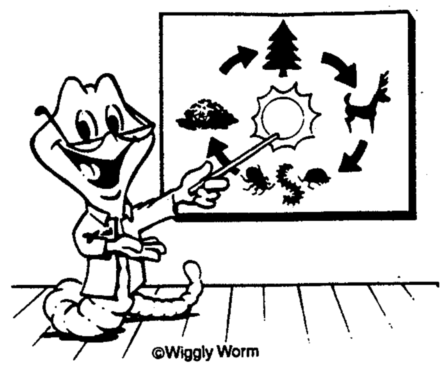
Explore the practical applications of scientific concepts and processes.
Physical sciences, earth sciences, life sciences and scientific processes.

All the fertile areas of this planet have at least once passed through the bodies of earthworms.
-Charles Darwin

Included are scientific concepts and processes taken from the 1990 California State Science Framework guidelines. These concepts can easily be integrated with composting. Many of the activities in this guide use scientific processes to explore these concepts. Teaching science and composting together, can help unite theoretical knowledge and practical applications. Concepts are listed by grade level groupings and are placed under the themes as they appear in the California State Science Framework. **Bold type, indicates information directly from the framework.** *Italic type, indicates suggestions for applying the concepts to school composting.* Underlined type denotes the suggested activities and page numbers.

ENERGY

GRADES: K-3



1. The sun is the source of most of the energy on earth. Coal and petroleum are the remains of green plants that lived and died millions of years ago. *When burning plant material or petroleum products, chemical energy that was converted from sunlight energy through photosynthesis is released. Plants are necessary to convert sunlight energy into chemical energy stored as sugars and starches.* Who Eats Who? 59

2. Temperatures flow from hot to cold. *Compost piles should be sufficient in size, (3ft. X 3ft.) to insulate and trap the heat given off by the decomposers metabolizing organic material. If compost piles are too small, the heat flows from the warm inside of the pile to the cool outer air.*

3. Heat is given off when food is metabolized. *Decomposers eat dead organic material and give off heat as they metabolize the food. Compost piles can reach 160 degrees Fahrenheit. Use a compost thermometer to take the temperature of a compost pile.*

GRADES: 3-6

1. Energy passes through ecosystems in food chains. Through photosynthesis, green plants convert light energy from the sun into chemical energy in the form of sugars and starches. All

organisms convert some of this chemical energy that they get through food into heat. Animals also convert some of this chemical energy into mechanical energy. *Decomposers are critical links in any food chain. Without decomposers, dead materials would pile up and plants would not have the nutrients they need to photosynthesize and produce food.* Dirt For Lunch 61, Who Eats Who? 59

GEOLOGY AND NATURAL RESOURCES

GRADES: K-3

1. Rocks are made up of minerals which are composed of specific combinations of pure elements in the earth. *Plants need minerals to grow. Decomposers produce organic acids which release minerals trapped in rock and make them available to plants.* Alien Explorers 36

2. All resources used by people come from the earth and in nature would go back to the earth. Many of these resources *(such as topsoil)*, **have taken thousands of millions of years to accumulate and must be used with care, conserved and recycled.** *Composting provides an environment for decomposers to recycle organic material. Sending organic material to the landfill breaks this nutrient cycle. What makes something a resource? What makes something waste? In nature, the waste of one thing becomes a resource for another.* Alien Explorers 36, Out of Sight, Out of Mind 69, Lunch Leftovers 75

GRADES: 3-6

1. Some resources are replaced at such slow rates that for all practical purposes they are nonrenewable. Poor soil management leads to incredible amounts of topsoil or humus eroding away. *In nature humus is created at very slow rates. Composting can help speed the rate that humus is created. Soil fertility is connected with the amount of humus in a soil.* Alien Explorers 36, To Decompose or Not to Decompose, That Is The Question 38

OCEANOGRAPHY

GRADES: K-6

1. People past and present, dump trash and other wastes in the ocean. What effect does this human practice have on ocean life? *Compare the effects of dumping different kinds of wastes, toxics, organics, mixed trash etc. in the ocean as compared to land filling, recycling and composting.* Out of Sight Out Of Mind 69, It's Not Waste Until It's Wasted 73

LIVING THINGS

GRADES: K-3

1. Living vs. non-living things take in nutrients, give off wastes, grow, reproduce and respond to stimuli from the environment. *Even microscopic bacteria meet the criteria for a living thing. The living vs. non-living categories can help students identify if a material is organic or inorganic and whether it will decompose easily.* Fungi and Bacteria 33, To Decompose or Not to Decompose, That Is The Question 38

GRADES: 3-6

1. **Multi-celled organisms have differentiated tissues,** *(earthworms).* **One-celled organisms perform different functions with cell membranes,** *(bacteria).* Fungi and Bacteria 33, Fun Facts About Red Worms 46

2. **Different organisms reproduce sexually or asexually. Different organisms show variation in reproductive strategies, rate of birth, growth, rate of reproduction and death.** *Compost contains many different types of organisms displaying many types of sexual and asexual reproduction strategies, along with different birth, growth, reproductive and death rates. Earthworms are hermaphroditic, having both male and female reproductive organs.* Worm Bin Check-Up 52

HUMAN INTERACTIONS WITH OTHER LIVING THINGS

GRADES: K-3

1. **Humans use and are dependent upon other living things and resources. Humans need to respect these living things and resources.** *Brainstorm where things come from; food, clothes, paper, toys etc. What living things and earth processes are necessary for us to produce these things. Every living thing has a job that contributes to the healthful working of the whole. ie. microorganisms in a compost or farm soil are necessary for us to have food. Humans need to take care that human activities do not harm other organisms' abilities to do their job, (ie. dumping toxic chemicals on soil.)* Who Eats Who? 59, Dirt For Lunch 61

GRADES: 3-6

1. **Humans are dependent on the biosphere in ways we do not yet realize. Humans need to exercise judgment, care and planning in their use of natural resources, and in their practices of disposing of wastewater and pollutants. Humans and human-related activities cause many extinctions.** *Find historical examples of humans harming the environment through ignorance of the ways we are all interconnected (DDT poisoning, CFCs and ozone depletion).* The Long Journey 62, Who Eats Who? 59, Town Meeting 79

ECOSYSTEMS

GRADES: K-3

1. **Living things need resources from their environment in order to sustain life and help them grow.** *They need specific amounts of food, water, and space to live and grow optimally. What is the optimal amount of food, water, and space for the decomposers in your compost? When setting up and maintaining a compost, humans are responsible for providing the resources and maintaining proper environmental conditions for decomposers to thrive.* Bedding Bets 53, Landing In A New Land 44, Worm Bin Check-Up 52

2. **Living things are found in particular places because the conditions they need to survive are met.** *In the school yard, notice that different types of plants grow in different places. Notice the amount of humus, water and sunlight that different spots get throughout the day.* Bedding Bets 53, Landing In A New Land 44

3. Green plants are the foundation of the energy flow in most ecosystems. Green plants produce their own food through photosynthesis, using sunlight, water, air and minerals from their environments. Energy is moved upward through food chains and food webs as animals eat plants or other animals. Energy is transferred back to the base of a food chain when organisms die and decompose, recycling nutrients back into the soil. *Composting is a way for humans to structure their activities to work within this energy flow cycle by returning the nutrients stored in organic material back to the soil, instead of breaking the cycle, by sending organic material to a landfill.* Who Eats Who? 59, Dirt For Lunch 61

GRADES: 3-6

1. All living things interact with each other and with the physical environment. *Food webs illustrate these interactions. The type and fertility of a soil and the plants growing out of that soil are the basis of a food web.* Who Eats Who? 59, Landing In A New Land 44

2. All organisms are part of their environment and need things from their environment to help them live and grow. All organisms influence and are influenced by their environments. *Soils are built up over time by organisms living, dying and decomposing in a particular place. As soils improve, different plants are able to grow in an environment. These plants go on to further change the environment. As a rule, the more life in an environment, the more life support systems there are to sustain and increase the diversity and amount of life in an environment.* Landing In A New Land 44, Growing Plants With Compost 41

3. All organisms have roles in their environment. *Explore different decomposers' roles in a compost system.* Fungi And Bacteria 33, Decomposer Tag 35

4. A change in the physical environment, ie. temperature, food, or moisture, can effect the entire system. *Apply this concept to a compost pile. Experiment by changing one thing, observe and record the changes in the system. When trouble shooting a compost, ask yourself "What has recently changed?"* Bedding Bets 53, Worm Bin Check-Up 52

5. Species move in and out, die and evolve, as conditions change in an ecosystem. If conditions change too fast or too drastically, beyond the population's present ability to adapt, they die. *Composts are ecosystems where conditions are constantly changing. Students can observe a continual parade of organisms going through boom and bust cycles as conditions change from being perfect, to out of a species' ability to adapt. Humans do not decompose organic material but they can help the composting process by providing ideal conditions that support the largest number of the most efficient decomposers.* Bedding Bets 53, Worm Bin Check-Up 52

RESPONSIBILITY OF HUMANS TOWARDS ECOSYSTEMS

GRADES: K-3

1. Humans depend on other species for their basic needs. We should foster respect for other species and be concerned with their survival. We should conserve resources. *Sending organic material to the landfill instead of returning it to the earth is a waste of resources and shows disrespect for the* *earth and the natural processes that we and the earth depend on. Students can draw pictures showing the effects of organic material being returned to the earth and organic material being wasted in a landfill.* Out Of Sight, Out Of Mind 69 , Save! Sort! Recycle! 77, Lunch Leftovers 75

GRADES: 3-6

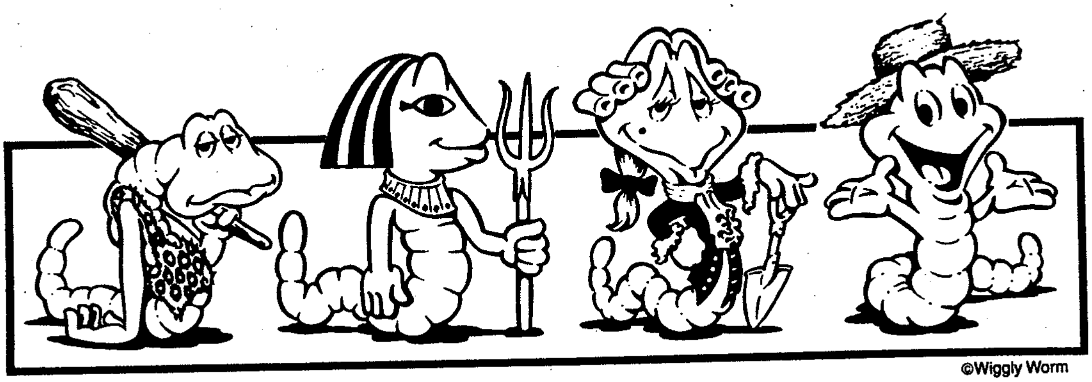
1. Waste disposal, the use of land, eliminating the feeding and breeding grounds of many species, hunting, collecting, pest control, the spread of toxics and the destruction of habitats through human caused disasters *such as wars, oil spills, accidents etc.* **have contributed to extinction of species and loss of their habitat and have threatened or destroyed ecosystems.** *As a class project, do reports on species which have become extinct or threatened through human actions. Include a section on how these extinctions could have been avoided.* Town Meeting 79, It's Not Waste, Until It's Wasted 73

SOIL FERTILITY AND ITS EFFECTS ON HISTORY AND CULTURE

A look at the connections between physical geography, natural resources and the development of civilizations. The use of natural resources is affected by cultural and historic attitudes.

History and social science.

The nation that destroys its soil, destroys itself.
-Franklin Delano Roosevelt



History and food are intimately connected. People wandered or settled in search of food. The development of agriculture profoundly effected the development of cities and the ways in which people organized themselves and interacted. Growing food is connected with soil fertility and the return of organic material to the earth, whether done naturally or in a human assisted system, such as composting.

Most environmental problems result from human considerations such as overpopulation, resource use and political systems that are out of balance with natural systems and cycles. Solving environmental problems requires the restructuring of values and participation in the political process.

Discussions of composting and soil fertility can be used to lead into the following topics taken from the California State History and Social Science Framework. Topics are listed by grade level. **Bold type indicates material taken from the state framework.** *Italics indicate suggestions for applying the topics to a school composting program.* Suggested activities and page numbers are underlined.

GRADE 1: A CHILD'S PLACE IN TIME AND SPACE

1. **Where does food come from?** *Have students brainstorm where food in their lunches came from.* Dirt For Lunch 61, Who Eats Who? 59

2. **Changes in land use in their community. Urbanization of agricultural land.** *Study the effects of channeling rivers. Investigate the loss of wildlife habitats. Interview old-timers about changes in the community.* It's Not Waste Until It's Wasted 73

3. **Visit farms that supply children's needs.** Dirt For Lunch 61, The Long Journey 62

4. **Map-out your community.** *Notice agricultural lands or land that used to be agricultural. Are some places better for farms than others? What is the connection between agricultural land and soil fertility? Are farms located in fertile river valleys?* Landing In A New Land 44

GRADE 2: PEOPLE WHO MAKE A DIFFERENCE

1. **Track the complex route and many miles that much of our food travels from farm, to processor, to market, to home.** *Is this complex route an efficient use of our resources? List the advantages and disadvantages of buying and eating home grown food vs. food grown far away.* Dirt For Lunch 61, The Long Journey 62

2. **Track the complex cradle to grave route our trash takes.** *What resources are used in the process. List the advantages and disadvantages of large municipal composting vs. small backyard composting.* Save! Sort! Recycle! 77, It's Not Waste, Until It's Wasted 73, I Can Compost 55

3. **Identify a great variety of foods. Some grown locally some from far away.** *Where did the food in your lunch come from?* Dirt For Lunch 61, The Long Journey 62

4. **Visit supermarkets and farmers markets.** *Compare the taste, freshness and price of locally grown food with food grown far away. Compare the different growing methods of organic and commercial agriculture. Do a taste test of organic vs. non-organic produce.* The Long Journey 62

5. **People are dependent on natural systems and cycles to grow food.** Who Eats Who? 59

6. **How does climate affect the crops a farmer can grow?** Landing In A New Land 44, The Long Journey 62

7. **Why are some areas more fertile than others?** Landing In A New Land 44

8. **What can happen to our food supply if farmlands are overused or rich farmlands are changed or rezoned for urban development?** Town Meeting 79

9. **Look at children's ancestors.** *What did your ancestors eat? How did they get their food? What farming methods did their culture use? What kind of trash did they produce and what did they do with it?* It's Not Waste, Until It's Wasted 73, Lunch Leftovers 75

GRADE 3: CONTINUITY AND CHANGE

1. **Discover who lived in your area before you did. How did these people use the land. What lasting changes did their land use practices create?** It's Not Waste, Until It's Wasted 73, Lunch Leftovers 75

2. **Take field trips into the immediate environment to establish familiarity with the major natural features and land forms of the region.** *What land is the most fertile? What natural processes (humus formation, erosion and deposition) made these areas fertile?* Landing In A New Land 44

3. Build a terrain model of the topography of the local region. *How are topography and soil erosion connected? Why did people settle where they did?* Landing In A New Land 44

4. Who were the first people who lived here? How did they use the resources of the region? What ways did they modify the natural environment? *What were their attitudes toward the earth?* It's Not Waste, Until it's Wasted 73, Lunch Leftovers 75

5. Study the locations of Native American villages and why they were located where they were. What methods did they use to get food? *What types and amounts of trash did they produce? What did they do with it?* It's Not Waste Until It's Wasted 73 Lunch Leftovers 75

6. The changing history of an area, at all stages, is closely related to the physical geography of a region: its topography, soil, water, mineral resources, and relative location. *How has the physical geography of the region affected local history?* Landing In A New Land 44

7. Look at how each period of settlement left its mark on the land and how decisions being made today also will leave their mark on the land. *How will decisions about what to do with our waste leave their mark on the land? What effect would many people composting have on the land? What marks have past waste disposal practices left on the land?* Town Meeting 79, Spreading The Word 85

8. How are people in the community working to protect natural resources? *What is being done with organic wastes in your community? What options does your community have for dealing with organic wastes?* Town Meeting 79, Save! Sort! Recycle! 77, I Can Compost 56, Spreading The Word 85

GRADE 4: CALIFORNIA, A CHANGING STATE

1. The strong influence of agriculture in California's past and present. *Topsoil from the Sierra Nevada mountains is washed downstream by huge rivers and deposited in California's Central Valley, the Delta and San Francisco Bay, making it one of the worlds most fertile agricultural and wildlife regions. (Forty percent of California's watershed drains into San Francisco Bay.) This same process of topsoil deposition and high soil fertility occurs in California's many coastal river valleys and flood plains. On the school grounds find examples of erosion creating mini river valleys and flood plains with silt deposited from above.* Landing In A New Land 44

2. Agriculture past and present is an important part of California's economy. Dirt For Lunch 61, The Long Journey 62

3. Native Americans in California used natural settings without significantly modifying the environment. *What attitudes, customs, tools and food gathering or raising techniques did Native Americans use which allowed them to interact with the natural environment without destroying it? Native Americans' trash piles are called middens. What do you think you would find in a midden? What is in your trash?* Lunch Leftovers 75, It's Not Waste, Until It's Wasted 73, Out Of Sight, Out Of Mind 69

4. Water politics has played a major role in California's development. *How does building dams and channeling rivers affect California's soil fertility?* Landing In A New Land 44

5. Students should study the development of California's large-scale commercial agriculture. *What are the costs and benefits of this type of agriculture? Who are the parties involved (banks, farmers,* *chemical companies, migrant workers, consumers, railroads, trucking companies, farm machinery producers)? What are the environmental effects of large-scale commercial farming?* The Long Journey 62

GRADE 5: UNITED STATES HISTORY AND GEOGRAPHY

1. **Pre-Columbian native settlements can be examined from the stand point of food stuffs, soil fertilization and agricultural techniques.** Lunch Leftovers 75, It's Not Waste, Until It's Wasted 73

2. **The economy at the Virginia settlement of Jamestown was perilous until John Rolfe introduced West Indian tobacco as a cash crop, which became the foundation of the plantation economy.** Landing In A New Land 44

3. **Why was tobacco grown on large plantations? What type of work force was required?** *How are slavery, soil fertility and the warm climate of the south connected?*

4. *Many of America's founding fathers were also farmers.*

GRADE 6: WORLD HISTORY AND GEOGRAPHY: ANCIENT CIVILIZATIONS

1. **The Sumerians made their early settlements in the fertile crescent between the Tigris and Euphrates rivers. By 4000 BC. Sumerian agricultural villages had spread to lower Mesopotamia.** Landing In A New Land 44

2. **Students should consider the critical geographic relationships between site, resources and settlements (exemplified in the river valleys of Mesopotamia, Egypt, India and China,)when examining why societies developed where they did. The development of agriculture helped bring about city-states.** Landing In A New Land 44

DEVELOPING COMMUNICATION SKILLS

Spreading the Word About Composting

Language arts / fine arts.

Below are a few suggestions, designed to get your mind thinking of ways to integrate composting into your language arts and fine arts curriculum. Most of the activities in this guide require the use of language arts or fine arts skills. Many of the extension activities come from this list. Grade level indications are not given since many of these projects are adaptable to various grade levels. Suggested activities are underlined.

1. Most of the compost experiments require students to make observations, record the data and communicate the results. Fungi And Bacteria 33, Growing Plants with Compost 41.

2. It is suggested that students have a compost journal to record all their compost activities and experiments. Alien Explorers 36, I Can Compost 56

3. Students can be asked to give written answers to discussion questions which are part of many activities. It's Not Waste, Until It's Wasted 73, The Long Journey 62, Out of Sight Out of Mind 69

4. Students can form compost pen pals withother classrooms or schools, sharing and comparing compost data in the same way the scientific community shares their findings. To Decompose or Not To Decompose, That Is The Question 38, Bedding Bets 53 Skin Deep 39

5. Students describe in speeches or writing, the composting process. Spreading The Word 85

6. Use different poem formats with composting as the subject. Who Eats Who? 59, I Can Compost 56

7. Students may develop and present workshops on how to compost for other students, parents, neighbors and school boards. Spreading The Word 85

8. Letters and articles explaining composting or lobbying for compost programs may be sent to newspapers, magazines or public officials. Spreading The Word 85, Town Meeting 79

9. Thank you letters may be written to people who donated materials or time to help with your classroom's composting projects. How Big a Worm Bin? 47, Spreading The Word 85

10. The possibilities for creative writing projects related to composting are many. A few examples would be: "A Day in The Life of a Worm", "Wiggly Worm in Worm Boxland" or "What Does it Feel Like to Decompose?". To Decompose or Not To Decompose, That Is The Question 38

11. Students can staff compost demonstration tables at community events, school fairs, farmers markets etc. Students can develop written material on composting to hand out at these events. Spreading The Word 85

12. Computers can be used to produce pamphlets on composting. Spreading The Word 85

13. Skits, plays, songs, commercials and videos can be produced showing how or why to compost. Titles to popular movies, songs or television shows can be changed to reflect a compost theme. Alien Explorers 36, Spreading The Word 85

14. Students can write and illustrate a children's storybook on composting. Spreading The Word 85

15. Posters, encouraging composting, can be created and posted around school. Spreading The Word 85

16. Bilingual posters and pamphlets can be created and distributed in bilingual neighborhoods. Spreading The Word 85

17. Compost containers and bins can be painted and decorated. How Big a Worm Bin? 47

18. Compost T-shirts can be painted or silk-screened. These T-shirts can be worn by students and/or sold at school and community events. Spreading The Word 85

USING MATH IN REAL SITUATIONS

Setting up compost systems and performing compost experiments provides students with many opportunities to understand mathematic principles and perform calculations. Listed below by grade level and California State Framework classifications are math related projects that can be connected into composting. **Bold type indicates material taken from the California State Framework.** Underlined type indicates suggested activities and page numbers.

ATTRIBUTES AND CLASSIFICATIONS

GRADES: K-1

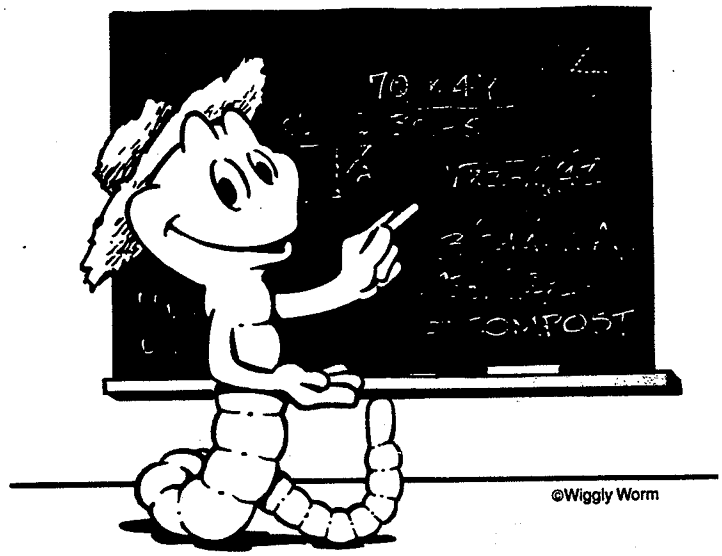
1. **Identify attributes as students sort objects.** Save! Sort! Recycle! 77

GRADES: 2-3

1. **Classify things by twos and threes, and fuzzy attributes with no clear cut boundaries.** Save! Sort! Recycle! 77, Lunch Leftovers 75, I Can Compost 56

2. **Students construct sorting puzzles guessing the attribute or the rule.** Save! Sort! Recycle! 77

3. **Develop ways of recording and communicating their classification systems.** Fungi and Bacteria 33, Bedding Bets 53



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GRADES: 4-5

1. **Classify many things using numbers, geometric shapes, Venn diagrams etc.** Save! Sort! Recycle! 77, Out Of Sight, Out Of Mind 69

NUMBERS AND NUMERATION

GRADES: K-1

1. **Count objects and arrange objects to show concrete numbers.** Worm Bin Check-Up 52, Growing Plants With Compost 41

2. **Cut objects into 1/2 and 1/4's.** How Big A Worm Bin? 47, Skin Deep 39

GRADES: 2-3

1. **Count larger numbers.** Growing Plants With Compost 41

2. **Learn fractions and decimals.** Skin Deep 39, How Big A Worm Bin? 47, Out Of Sight, Out Of Mind 69

GRADES: 4-5

1. **Interchange decimals and fractions.** How Big A Worm Bin? 47, Growing Plants With Compost 41

2. **Look for numerical or geometric patterns.** Out Of Sight, Out Of Mind 69

UNDERSTANDING ARITHMETIC

GRADES: K-1

1. **Use counting, addition and subtraction in everyday situations.** Worm Bin Check-Up 52

GRADES: 2-3

1. **Draw pictures or diagrams to illustrate situations.** Who Eats Who? 59, Skin Deep 39

2. **Learn interchangability of addition and subtraction.** How Big A Worm Bin? 47

3. **Study area by placing tiles on the bottom of boxes.** How Big A Worm Bin? 47

GRADES: 3-4

1. **Solve more complex problems, discuss why different approaches yield the same results.** How Big A Worm Bin? 47, Out Of Sight, Out Of Mind 69

DEALING WITH DATA

GRADES: K-1

1. **Students count and measure to collect data.** Growing Plants With Compost 41, Fungi and Bacteria 33

2. **Classify data by kind and record findings with simple graphs and pictures.** Growing Plants With Compost 41, Fungi and Bacteria 33

GRADES: 2-3

1. **Graph and summarize the results of data collection.** Skin Deep 39, Fungi and Bacteria 33, Bedding Bets 53

2. **Create simple surveys. Discuss and decide on categories for organizing information and discuss how categories overlap.** Save, Sort, Recycle 77, Spreading The Word 85

3. **Study different ways of displaying data with, Venn diagrams, graphs, and tables.** Fungi and Bacteria 33, Skin Deep39, Bedding Bets 53

GRADES: 4-5

1. **Research questions of interest, collect data, organize data, display it on graphs and interpret the results.** Growing Plants With Compost 41, Skin Deep 39, Fungi and Bacteria 33

2. **Examine data from the media and speculate on how the data was gathered.** Out of Sight, Out Of Mind 69, Spreading The Word 85

3. **Undertake sampling experiments and compare from a number of samples with the total population. Survey a random sample.** Lunch Leftovers 75

LOCATING AND MAPPING

GRADES: 2-3

1. **Estimate distances to locations in the room and school. Write directions and model directions on maps. Draw a floor plan of the room or school yard.** Landing In A New Land 44

GRADES: 4-5

1. **Create enlarged or reduced size drawings or models. Begin to interpret scale drawings and models. Make maps and write directions to buried treasures and follow each other's maps.** Landing In A New Land 44

VISUALIZING AND REPRESENTING SHAPES

GRADES: 4-5

1. **Identify and describe the properties of shapes and relationships among them. Study the relationships between two dimensional and three dimensional objects. Draw three dimensional objects.** How Big A Worm Bin? 47

EXCHANGE

GRADES: 2-3

1. Explore, exchange and place value using money. How Big A Worm Bin? 47

GRADES: 4-5

1. How much does something cost? Research prices and do comparison shopping. Research the price of component parts and calculate the total cost including tax. Different groups report findings of comparison shopping including factors that influenced choices. Explore the concept of substituting equivalent measurements. How Big A Worm Bin? 47, Spreading The Word 85

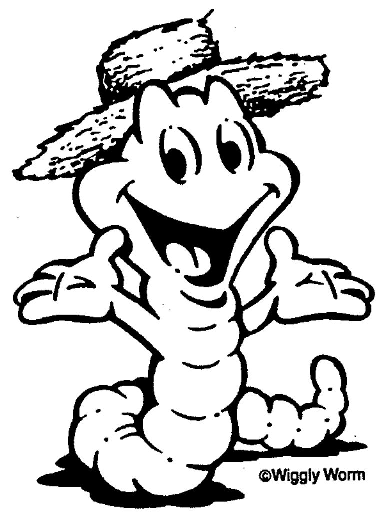
BACKYARD COMPOSTING

This method is what people usually refer to as a compost pile. The term "backyard composting" is used to distinguish it from worm composting which is also an aerobic composting process, or municipal composting.

HOW IT WORKS

In a backyard compost there are trillions and trillions of decomposers digesting dead organic material and turning it into dark, rich, earthy smelling humus. Macroorganisms, the ones large enough to see, such as earthworms, sow bugs and centipedes, enter your compost from the garden, chew material into smaller pieces and feed off the microorganisms. Microorganisms, those too small to see, (bacteria, fungi and actinomycetes) are on everything and do the majority of the decomposition.

A compost has its own evolution and life cycle. Environmental conditions in a compost are constantly changing and with them, the types of organisms that thrive under those conditions. Maintaining environmental conditions suited to aerobic or air-loving bacteria, will insure that you have quick, clean, sweet smelling compost. A lack of oxygen breeds anaerobic bacteria, which give off bad smells.



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INGREDIENTS

There are many variations on composting but here are the basic ingredients necessary to maintain conditions favorable for aerobic bacteria.

1. ***Carbon rich organics.*** Usually brown in color from woody dry materials such as sawdust, dry leaves and straw. Carbon provides microorganisms with the energy they need, just as carbohydrates provide much of the energy we get from foods.

2. ***Nitrogen rich organics.*** Usually green, wet, and gloppy such as kitchen scraps, green grass cuttings, fresh garden cuttings and manures. Nitrogen helps microorganisms build their bodies.

3. ***Moisture.*** As wet as a wrung out sponge. Water is necessary for all life. Aerobic bacteria thrive in damp but not soggy conditions. Too much water displaces all the air creating a soggy, smelly, anaerobic compost.

4. *Air.* This is provided by turning the pile or inserting air tubes into it when building. Everything else being equal, the amount of air in a pile dramatically increases the rate of decomposition. A pile that is turned twice weekly can decompose 10 times faster than a pile never turned.

THE COMPOST RECIPE

1. *CHOP* very large woody materials to create more surface area for decomposers to feed on. (A log in the forest will decompose but will take years; the same volume of twigs can decompose in one season.)

2. *MIX* carbon rich materials with nitrogen rich materials, trying to achieve a 30:1, carbon to nitrogen ratio. Accquiring a sense of the carbon to nitrogen ratios in different materials will help you build a pile with optimal conditions. A compost too high in carbon will take longer to decompose. A compost too high in nitrogen can get gloppy and anaerobic. It is better to err on the carbon rich side, and add more nitrogen later if it is not breaking down. You can build your pile by alternating layers of carbon rich material and layers of nitrogen rich materials or you can mix carbon and nitrogen materials together.

CARBON / NITROGEN RATIOS

	C:N	
Kitchen scraps	10:1	Materials high
Alfalfa hay	13:1	in nitrogen.
Typical herbivore manure	15:1	
Seaweed	19:1	
Green grass clippings	20:1	
Coffee grounds	25:1	Materials close to a
Green yard trimmings	30:1	30:1 C/N ratio.
Dry leaves	40:1	
Straw	80:1	
Paper	170:1	Materials high
Sawdust	400:1	in carbon.

All organic material will decompose, but for public health and safety reasons do not compost meat, bones, dairy products, fish, greasy foods, dog and cat feces, toxic materials, invasive weeds, or diseased plants.

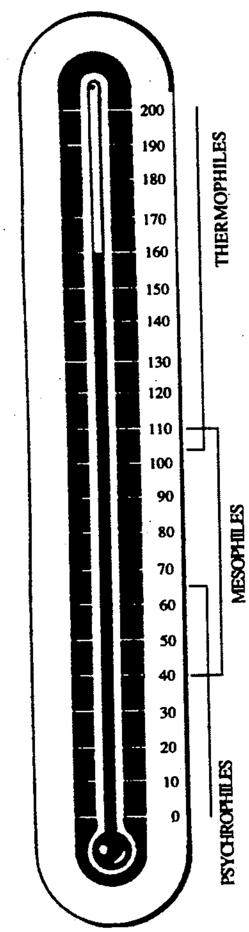
3. *WATER* As wet as a wrung out sponge. Covering your compost with a tarp or old carpet can help keep moisture in and excess rain water out.

4. *AERATE* For hot fast compost turn your pile often, up to three times a week. For no fuss slow compost only turn your compost if it gets anaerobic and smelly.

TEMPERATURE

An aerobic compost pile 3ft X 3ft or larger can insulate itself enough to reach 160 F °. Bacteria give off metabolic (body) heat. As their populations increase more and more heat is given off and trapped in the center of the pile. Psychrophilic bacteria, those thriving at temperatures of 60 F° and below, work slowly but as temperatures rise, more efficient bacteria, fungi and actinomycetes, living between 40-110 F°, take over. As temperatures reach 105-170 F °, thermophilic bacteria speed decomposition and heat up the compost, killing most weed seeds and plant pathogens.

Compost will cool down after awhile and heat up again if you turn it. Once the compost stops heating up and the original ingredients have transformed to dark, rich, crumbly, sweet-smelling humus your compost is finished and ready to use.



UTILIZATION

Compost improves soil structure, holds water and nutrients, adds minerals and innoculates the soil with beneficial soil organisms. Finished compost is an excellent soil amendment that can be used in many ways.

1. *AMEND:* Spread compost over your garden and dig it in.
2. *MULCH:* Put compost under existing plants, trees and shrubs.
3. *ROWS:* Add compost to rows before planting.
4. *POTTING MEDIA:* Mix equal parts compost and soil or sand.
5. *COMPOST TEA:* Fill a burlap sack with compost and soak in a barrel of water for two days. Feed the clear brown, nutrient rich water to your plants.
6. *SEED FLATS:* Mix thoroughly digested compost with sand, soil or peat moss for seed flats.

STRUCTURES

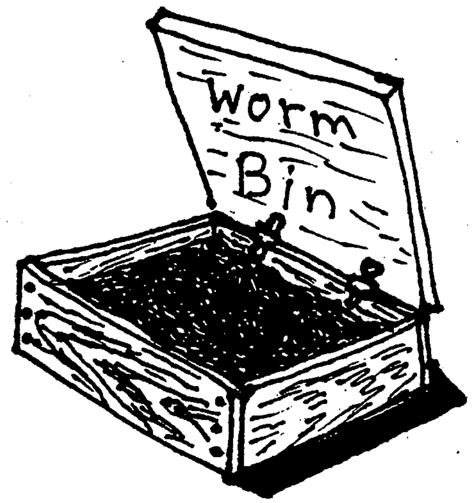
Compost can be contained in many ways, from a mound of yard trimmings piled in a corner of the yard to expensive commercial tumblers. How you contain your compost largely depends upon personal preferences. The size, what it is made of, ease of use, aesthetics and expense are considerations. Structures are available commercially and many can be made at home. (See Appendix B. for more information on compost bin designs.) ***If you are composting food scraps, your compost bin should be rodent proof, with a floor, a tight fitting lid and no opening larger than a 1/4 inch.***

Backyard Composting Troubleshooting

Symptoms	Problems	Solutions
Pile not composting	Too dry	Moisten till slightly damp
	Too much dry-woody material	Turn, add fresh green materials or organic nitrogen fertilizer
Pile smells rotten and/or attracts flies	Too wet	Turn, add dry-woody materials
	Non-compostables present	Remove meat, grease, etc., and turn
Rodents in pile	Food wastes in open bin, holes larger than 1/4 inch	Turn compost and rodent-proof your bin
	Non-compostables present	Remove meat, grease, etc., and turn

WORM OR VERMICOMPOSTING

Worm composting is a fun, low maintenance way of recycling your organic kitchen scraps. Worms eat your garbage, turning it into a high quality fertilizer known as worm castings. Worm composting utilizes the natural decomposition process going on all the time. You provide the bin, bedding and food and the worms do the rest by recycling valuable nutrients back to the soil. Worm composting is perfect for a classroom or apartment dwellers, without large yards. Worm composting can be done inside or outside, is used primarily for food scraps, requires no turning, is odorless and can be done in small spaces.



GETTING STARTED. You will need

1. *red worms*
2. *a collection container for food scraps*
3. *a worm bin*
4. *bedding*
5. *food scraps*

RED WORMS. You will need a pound or two of earthworms known as red worms or red wrigglers. These are the same worms people use for fishing. The worms found in your garden are probably another species. Red worms seem to be optimal for composting. They multiply quickly, are surface feeders, eat the same stuff we do and are available commercially. In nature, red worms are found in leaf mold and manure piles. You can get red worms from bait shops, gardening stores, commercial worm growers or worm composters.

There can be 500-2000 red worms in a pound depending on the size of the worms. Some people sell worms by the pound, others sell them by the number. A thousand worms can cost anywhere from $15-25. Unless you have a large worm box that more than one classroom is using, you need to purchase only a pound or two of worms, to get started. In a healthy environment, red worms reproduce quickly. Feed them slowly in the beginning. After a month or two they will adapt to their new home and start reproducing.

FOOD COLLECTION CONTAINERS. Five gallon plastic buckets with lids work well for collecting food scraps. The lid should be left on except when food is being put in. Food scraps will start decomposing in the bucket and may smell a little since there is a lack of oxygen in the closed bucket. This is fine. Empty the bucket into the compost once a week and rinse out the bucket. If there are fruit flies in the bucket, a handful of saw dust, dirt or leaves can be tossed over each day's newly added food.

WORM BINS. To size a worm bin for a household, figure one square foot of surface area per one to two people. In a classroom, students are only saving scraps from lunch and have no kitchen scraps so figure one square foot of surface area for every five to seven students. Another measure you can use is one pound of food per week for every square foot of surface area. (See the activity How Big A Worm Bin? for more information)

Red worms are surface feeders. A wide shallow container 1-2 feet high gives them more room than a tall, deep container such as a trash can, although trash cans have successfully been used.

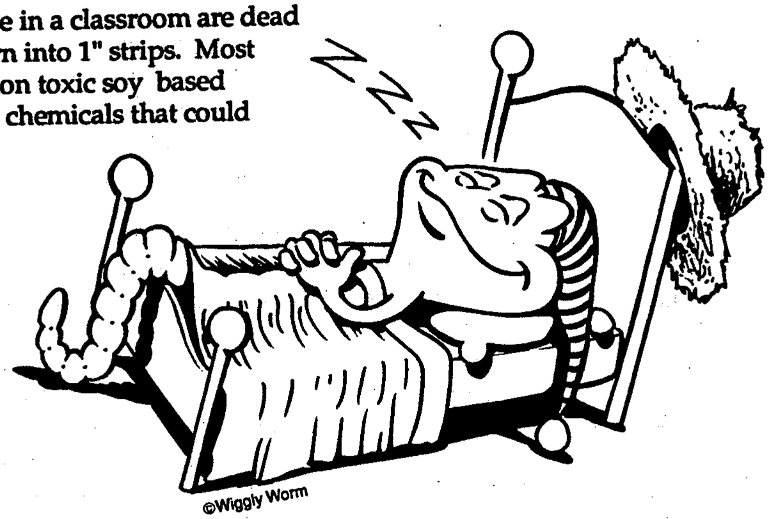
Worm Or Vermicomposting

Worm bins can be made out of wood or plastic. All should have holes drilled in the bottom. You can make wooden bins yourself and they can be of any size (see Appendix B). Eventually the wood will decompose, and in hot dry climates the compost may dry out faster. The outside of wooden worm bins can be painted and decorated. The inside should be left unpainted but can be treated with linseed oil to preserve it. Plastic bins come from petroleum, a nonrenewable resource. They will not decompose and will probably last longer than wood. Plastic bins may be lighter to carry and hold moisture better in dry climates. Plastic bins are available commercially. You may have trouble finding one large enough to handle all your classroom's food scraps, and may need more than one.

Since food scraps are being composted, all worm bins should have a well fitting lid and no opening larger than 1/4 inch, to make them rodent proof. Worm bins that are inside should have some kind of drip tray on the bottom.

BEDDING. Organic materials ranging from shredded cardboard to straw have been used for bedding material. The shredded bedding creates air space for the worms and is used to cover the food. The easiest and most available beddings to use in a classroom are dead leaves or black and white newspapers torn into 1" strips. Most black and white newspapers today use non toxic soy based inks. Colored and shiny paper may have chemicals that could harm the worms.

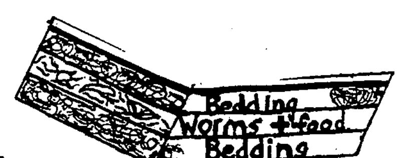
Dead leaves can be used for bedding. Leaves that are thin enough to crush easily in your hand, do not have strong smells, acids, plant toxins or are highly fibrous, work well. Alder, maple and sycamore leaves make excellent bedding. Leaves such as eucalyptus, oak or any type of needle should be avoided.



FOOD. Red worms eat anything we eat, plus food that has "gone bad" and the parts of fruits and veggies that we discard. Feed them all (tea bags, coffee grounds and filters, orange peels, egg shells, watermelon rind, etc.) of your kitchen scraps except meat, dairy or oils.

Worms will eat meat and dairy products but these high protein foods tend to putrefy when decomposing, giving off odors that could attract unwanted varmints. Oils tend to coat the food making it hard for the decomposers to eat through it.

THE STEPS



1. Fill bin 1/2 full with wet shredded newspaper or wet, dead leaves.
2. Add worms and food.
3. Fill the bin the rest of the way with wet shredded newspaper or dead leaves.
4. Cover with a piece of plastic or old carpet.
5. Put the lid on and leave the worms undisturbed for a week or so to adapt to their new home.

MAINTENANCE

As the worms, bacteria and other decomposers do their job, our job as humans is to maintain a hospitable environment for them to thrive.

MOISTURE AND TEMPERATURE. Red worms do best at temperatures between 50°-80° F inside the box. In snowy climates, your worm compost should be kept inside during winter. In hot dry climates, worms should be in the shade and watered if needed. Worm composts should be wet but not puddly. If there are puddles, you will get anaerobic decomposition and bad smells. Worms breathe through their skin. A worm's skin should be moist and glistening. If you see castings or bedding stuck to the worms the compost is too dry and needs water.

NO TURNING. Unlike other composting systems, worm composts should not be turned. Air holes in the container, the bedding and the tunneling action of the worms, provide enough circulation. The worms do not like to be disturbed; therefore, it is best to bury fresh food once a week as opposed to every day.

COLD COMPOST. Worm composts should not heat up like fast aerobic composts. The shallow dimensions of the container and the slower rate that food is added do not create conditions such as in an aerobic compost where enormous blooms of bacteria, generate metabolic heat that is trapped and insulated in the pile.

FEEDING. To feed the worms, simply pull back the top layer of bedding, put the food in the bin, spread it out so there are no large clumps, return the top layer of bedding, and cover with the plastic and lid. Periodically you will need to add bedding to the top. There should always be enough bedding to completely cover the food. If rotting food is left exposed fruit flies will tend to lay their eggs on it. Add bedding to the bottom only when starting a new box or after harvesting. Worms can go three to four weeks without being fed, but for longer periods you should find a wormsitter.

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START SLOW. Depending on how large your container is and how many worms you started with your worm compost will probably take a month or two (longer with huge containers) to reach capacity. As worms reproduce and their population increases, you can feed them more. It should look like the food is being processed into soil at the same rate they are being feed. Do not keep piling more and more food in if it is not decomposing.

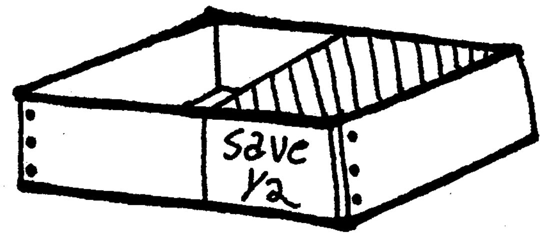
HARVESTING

Your worms will keep reproducing, turning your garbage into valuable castings (worm excrement) as long as they have food, space, and the proper temperature and moisture. When your container starts getting full and much of the material in it looks like soil, it is time to harvest. Your worm compost should be harvested at intervals from 4 months to a year, depending on how many worms you started with, how large your container is, how much you have been feeding them and how optimal their environmental conditions are. An over accumulation of worm castings will create an unhealthy environment for the worms.

COLLECTING THE FINISHED WORM COMPOST

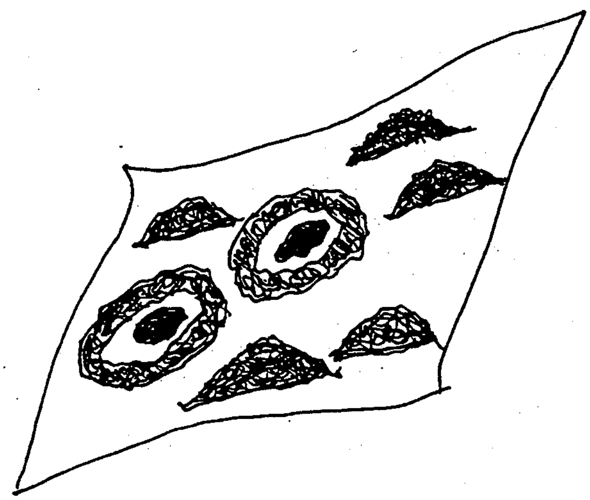
Method #1
Move the contents of the worm bin to one side. Add fresh bedding to the empty side and only bury food on this side. After a month or two many of the worms will have migrated to where the food is. You can now harvest the other side and add fresh bedding and food.

Method #2
Do not add any new food for a couple of weeks. Remove half the contents of your worm compost and add it directly to your garden soil, worms, castings and all. Add fresh food and bedding (Unless there is a lot of organic material in your garden the red worms will probably not survive in your soil.)



Method #3
Help others start a worm compost by giving or selling them some of your worm culture. Worm culture is the mixture of partly decomposed food, worms, cocoons, and castings. Remove up to half the worm culture in your container and add fresh bedding and food.

Method # 4
Dump the contents of the box out on a large sheet of plastic under the sun. Make a number of smaller piles. The worms will crawl away from the light towards the middle of the pile. Collect the castings from the outside of the piles. Add the wriggling masses of worms back into the container with fresh bedding and food.



USING WORM COMPOST

Worm compost is more concentrated and thoroughly digested than most other composts. For potting mixes, mix one part worm compost to three parts potting mix. For fertilizing, sprinkle worm compost around the base of plants before watering. Put worm compost in a cloth bag and steep in water, making a compost tea for your plants. Dig worm compost into your garden soil.

TROUBLESHOOTING

Composts are dynamic natural systems that change just as the seasons and cycles of nature change. The organisms in your worm compost will change as environmental conditions change. This is normal. Do not assume your compost is not working because suddenly there are fruit flies or ants. In nature, all decomposer organisms are useful, even though humans consider some a nuisance and want to discourage them.

WORM COMPOST TROUBLESHOOTING

Symptoms	Problems	Solutions
Worms are dying	Not enough food	Bury food into bedding
	Too dry	Moisten until slightly damp
	Too wet	Add bedding
	Too hot	Put bin in shade
	Accumulation of castings	Harvest worm compost, add fresh bedding
Bin smells rotten	No enough air circulation	Add fresh bedding. Gently turn over contents. Spread food out more evenly.
Flies in bin	Food exposed	Secure lid, add bedding to the top to cover food, cover worms and bedding with sheet of plastic or carpet.
Ants in bin	Too dry	Add water
	Lots of fruit	Spread fruit more evenly through bin. Add water.

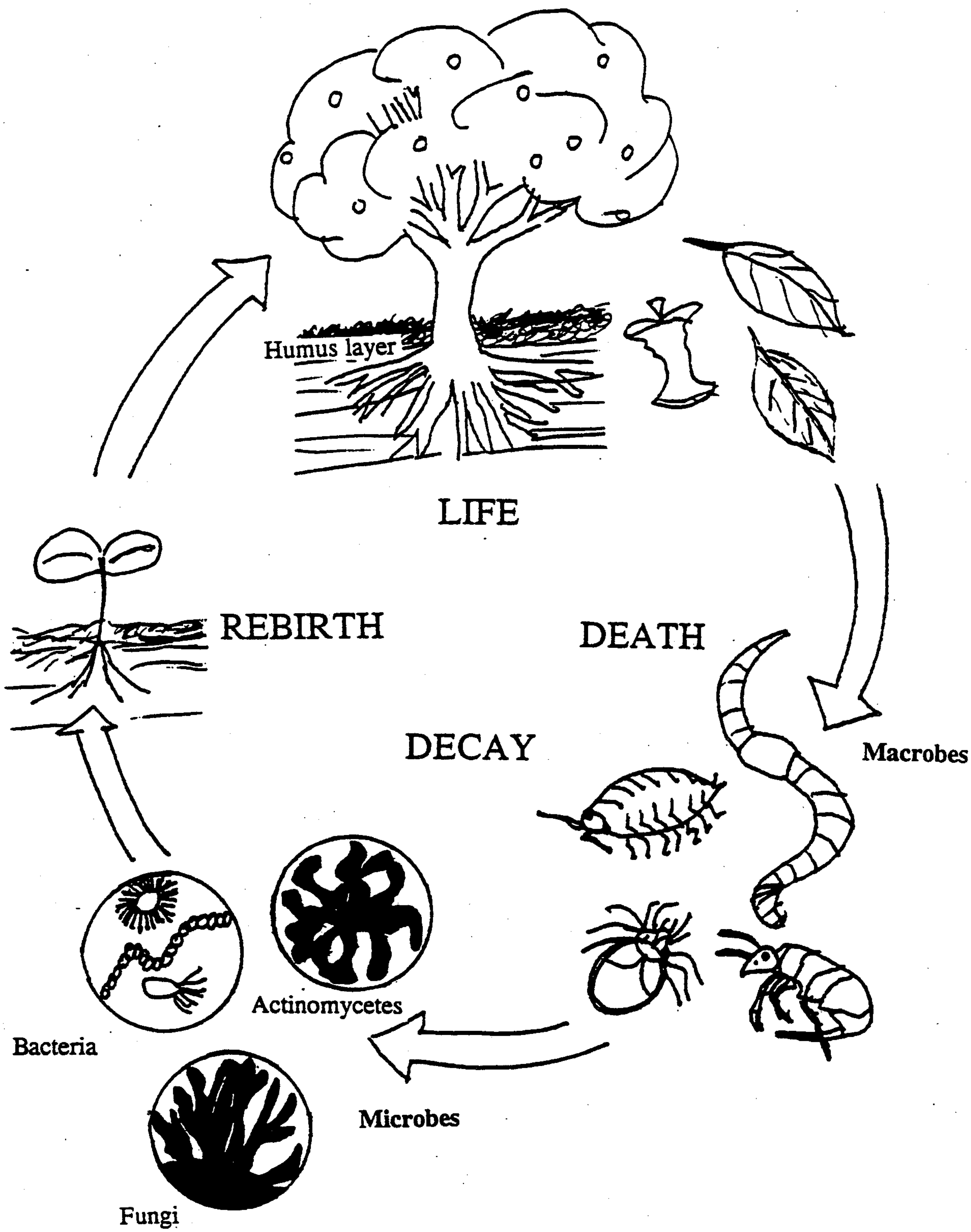
On Top

All this new stuff goes on top
turn it over, turn it over
wait and water down
from the dark bottom
turn it inside out
let it spread through
Sift down even.
Watch it sprout.

A mind like compost.

- Gary Snyder

Soil And Decomposition



FUNGI AND BACTERIA

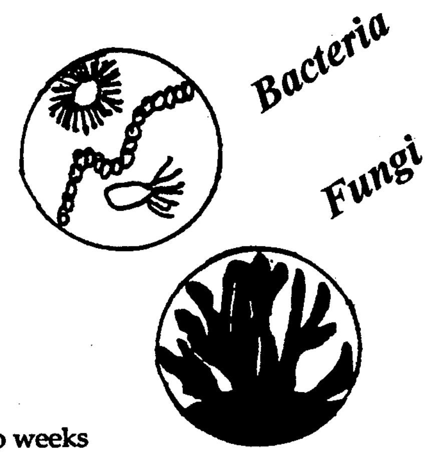
DESCRIPTION
Students compare the growth of fungi and bacteria in different environments.

OBJECTIVE
Students observe growth of fungi (yeast) and the effect of bacteria as organic matter is decomposed.

GRADE
2-6

TIME
One 30-minute period, one 15-minute period and observation periods over two weeks.

MATERIALS
Two slices of bread for each group of students
Two lemons or oranges for each group
Several bananas
A knife for you to cut the bananas
Six plastic bags for each group
Twist ties for each bag
One-half teaspoon of yeast for each group
Cotton balls
Masking tape
Water
A warm dark place to store things for two weeks
A refrigerator or cool place to store things for two weeks



BACKGROUND INFORMATION
Fungi and bacteria are essential to the decay of plant material. Fungi and bacteria are decomposers working at the microscopic level to help plants break down into their basic elements.

Moisture and darkness encourage rapid growth of fungi and some bacteria. Both of these factors help fungi and bacteria thrive.

PREPARATION
Decide on a warm dark place for bags to be kept during the experiment.

PROCEDURE

Day One

1. Ask the students how they think plants decompose, and what factors effect decomposition. What conditions do they think are the best to help plants decompose?

2. Explain that they are going to test how environmental conditions effect decomposition. Provide each group with six plastic bags and enough ties to secure them, two slices of bread, two oranges or lemons, and two pieces of banana.

3. In each of the two bags have the students place a slice of bread. One slice should be wet but not soggy. Nothing should be done to the other slice. Ask the students to seal both bags with ties. Place the bag with the moistened slice in a dark warm place and the other bag in the refrigerator, or a cool place.

4. In the other two bags, place a piece of banana. In one bag pour half a teaspoon of yeast on the banana and mark this bag with a "Y". Place both of these bags in a warm, dark place.

5. Rub the oranges or lemons on the floor and let them sit out in the air for one day.

Day Two

6. Place each orange or lemon into a bag. Add a cotton ball moistened with water to one of the bags. Tie both bags closed. Place the bag with the cotton ball in a warm, dark place and the other bag in a cool spot.

7. Have the students hypothesize what will happen to each of the items. What will the yeast do? What affect will temperature and light have?

During The Week

8. Twice during the week have students observe each bag and record their observations on the copycat page.

After One Week

9. The bread and banana should be well on their way to decomposing. Allow the students to observe the structures of mold and the decomposition of the bananas with a hand lens. Students can draw what they see on their copycat pages, or on separate sheets of paper. What has the yeast done to the banana? What role does moisture play?

Note: The oranges or lemons may take a week or longer to turn into bluish-green fuzz balls. If so, continue the experiment an extra week.

EXTENSION

Bake yeasted bread. The yeast are fungi that are alive. The fungi eat the honey or molasses in the dough and give off carbon dioxide as a by-product. The carbon dioxide gets trapped in the net of gluten fibers and causes the dough to rise.

Included with permission from:
Alameda County Home Compost Education Program
7977 Capwell Drive, Oakland, CA 94621, (510) 635-6275

COPYCAT PAGE

NAME ______________________

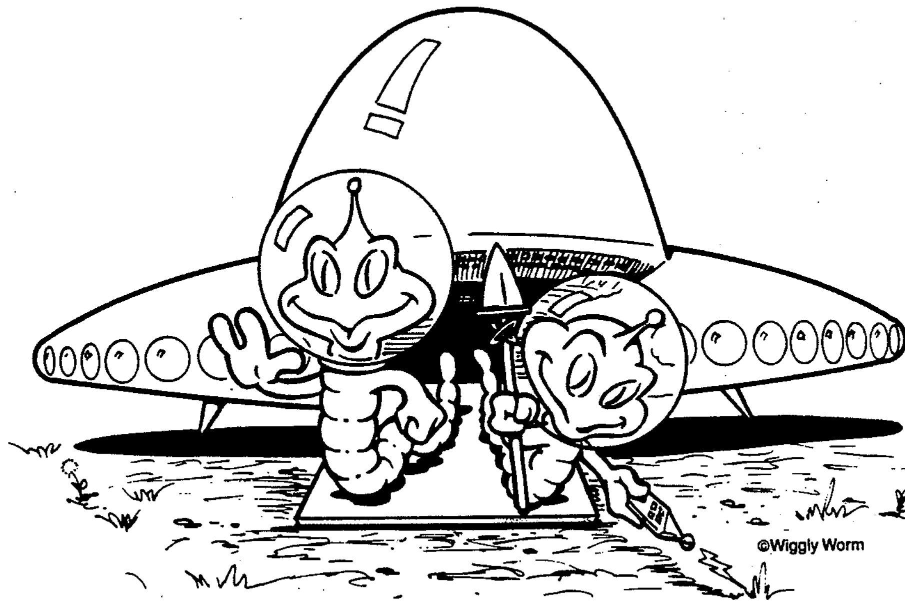
OBSERVATIONS

	Bread		Oranges/Lemons		Bananas	
Date	Wet/Warm	Dry/Cool	Wet/Warm	Dry/Cool	Wet/Warm	Dry/Cool

ALIEN EXPLORERS

DESCRIPTION Students become alien explorers studying the composition of soil.

OBJECTIVE Students explore the composition of various soils and learn that soil is more than the sum of its parts.



GRADE 2-5

TIME One class period

BACKGROUND INFORMATION Soil is more than the sum of its parts. The components of soil, sand, silt, clay, organic material and soil organisms, along with climate, erosion and other environmental factors, interact synergistically in forming soils. Soil organisms are the key factor in transforming soil components into soil. Soil organisms digest organic material, aerate the soil, and release acidic waste products which slowly dissolve rocks, making minerals trapped in the rocks available to plants.

Not all soils are the same. Soils differ in the relative amounts of each component. Some soils are more developed than others. As soils develop, they can progressively support larger and larger plants with higher and higher nutritional requirements. The more life in an ecosystem the more resources there are to increase the amount of life in that ecosystem. Depending on the climate, soils can take a very long time to develop. It's often quoted that it takes a 100 years for an inch of topsoil to develop.

MATERIALS A trowel and collection container for each group
Journals

TEACHER SCRIPT

"Fellow aliens, as you know we have spent many years traveling the universe surveying different planets' food production capacities. We have come to take particular interest in a planet called Earth. On Earth food grows out of the planet in a magical substance they call soil. Your assignment is to land on Earth, collect a sample of soil, record its components and bring back the necessary materials to manufacture soil."

PROCEDURE

1. Divide students into groups of three or four.
2. Read the script aloud to students.
3. Give each group a trowel and a container to collect the soil sample.
4. Each groups picks one spot in the school yard and collects a soil sample, digging the trowel straight down as deep as the blade will go.
5. Each group brings their soil sample back and records each ingredient they find in the sample.
6. Assign ingredients to each group and ask them to return with a small quantity of each ingredient.
7. Challenge groups to make soil by breaking apart and combining the raw ingredients, ie. breaking apart twigs and crushing rocks. When the frustration level of the students is reached, ask them whether soil can be manufactured. Why not? Explain that each inch of topsoil requires over 100 years to form. Bacteria, fungi, and other living things slowly eat and decompose organic material such as leaves and twigs and excrete acidic wastes that unlock minerals held in rocks. Trillions and trillions of microorganisms do the work of creating soil from the raw components.

EXTENSIONS

Compare the type and numbers of plants growing in different soil types. Note correlations between the amount of life in a soil and the amount of life above that soil.

Have students make up soil poems, skits, commercials or songs describing the components of soil and the processes organic matter goes through to become soil.

TO DECOMPOSE OR NOT TO DECOMPOSE, THAT IS THE QUESTION

DESCRIPTION

Students bury various organic and inorganic objects in the ground and dig them up weekly to observe changes and chart the various rates of decomposition.

OBJECTIVE

To observe that different substances decay at different rates.

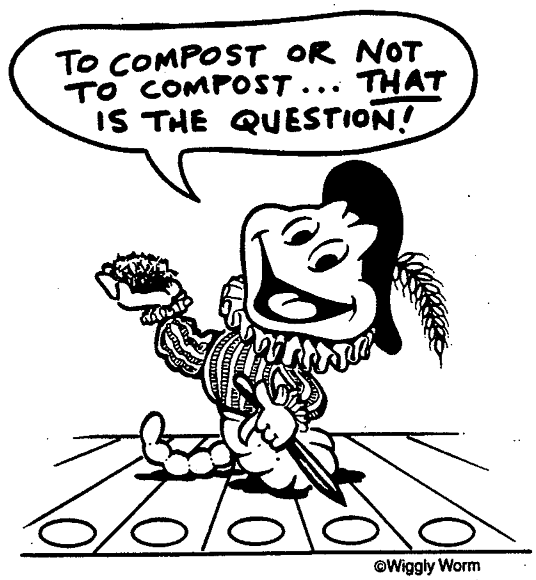
GRADE

4-6

On-going project

TIME

A variety of organic and inorganic objects. Various decomposing and non- decomposing materials:



MATERIALS

A nail
A nylon rope
A bone
A plastic container
Fruit and vegetable peelings
A cotton sock
A newspaper
Grass clippings
Journals
Sticks as markers

PROCEDURE

1. Have students bury each item in a different hole, all of the same depth. Mark each spot with a stick.
2. Once a week, have students dig up the items and record how fast and in what ways each item is decaying.
3. Make a graph charting the rate at which different objects decompose.

DISCUSSION

What in the ground is causing the objects to decompose? What characteristics make an object decompose quickly or slowly? Will the type of soil an object is buried in change how fast it decomposes? How quickly or slowly would these objects decompose in a landfill?

EXTENSIONS

Repeat the experiment, burying objects in different soil types and compare the results.

Do a creative writing project such as "What does it feel like to decompose?" or "A day in the life of a worm."

SKIN DEEP

DESCRIPTION Students bury fruit cut into different size pieces in either a worm compost or a backyard compost and record decomposition rates.

OBJECTIVE Students will see that cutting up organic material speeds decomposition by creating more surface area for decomposers to feed on. Students will see how skin acts as a protective covering to keep microorganisms out.

GRADE 2-8

TIME On-going project

MATERIALS
Four whole fruits of the same type (i.e., four apples, melons, or tomatoes)
A cutting knife
A compost system to bury the food in (if you do not have a compost system, food can be buried ten inches in fertile soil)
Popsicle sticks
Journals

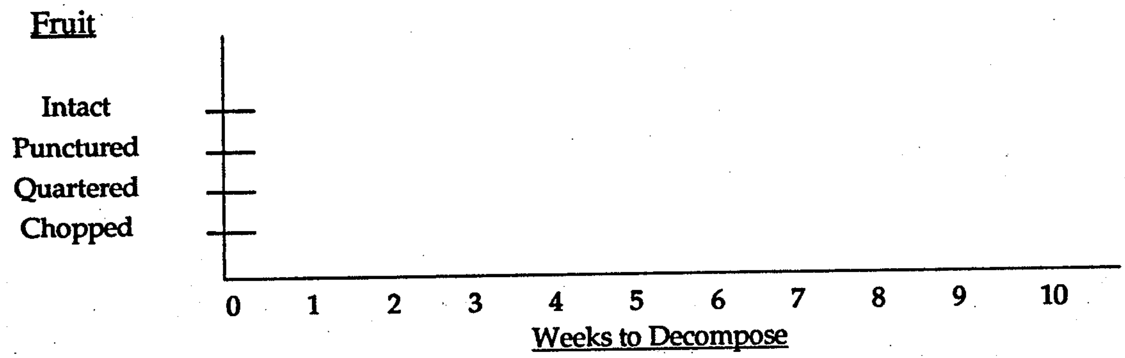
PROCEDURE

1. Use one corner of your compost bin to bury the food.
2. Take the four pieces of fruit; leave one intact with the skin unbroken; puncture the skin of one with a knife; cut one in fourths and chop the last one into many small pieces.
3. Bury each of the fruits in the compost or the ground and mark with a labeled popsicle stick.
4. Mark where you buried each fruit. Dig up and check weekly.
5. Record the rate at which each fruit is decomposing in relation to the amount of surface area available for decomposers to feed off of.
6. Record where the decomposition has started and what part of the fruit it is spreading to.

EXTENSION Graph the relationship between the number of pieces the fruit was cut into, and how many weeks it took to completely decompose. Repeat the experiment with another type of fruit and compare results. Find examples in nature of the same materials decomposing at different rates due to differences in surface area.

DISCUSSION Which would decompose faster, a 200 pound log or 200 pounds of small twigs? In what situations would it be reasonable to buy large expensive equipment and use fossil fuels to chop organic materials into smaller pieces? What was the difference between the fruit with the skin intact and the one with a puncture in the skin? How does skin act as a protective covering. When humans get a cut why should they clean it and cover it as soon as possible?

Rate of Decomposition



GROWING PLANTS WITH COMPOST

DESCRIPTION

An experiment to observe how plants germinate and grow with varying amounts of compost.

OBJECTIVE

To see if adding compost to the soil has an effect on the sprouting of seeds and the growth of plants.

GRADE

2-Adult

TIME

On-going project

BACKGROUND INFORMATION

Adding compost to the soil can increase the soil's ability to hold water. In addition, compost can add nutrients to the soil. This helps the plants in your garden to grow. On the other hand, it is difficult for seeds to sprout in pure compost. In fact, sensitive seeds may even be killed by a fungus if you try to sprout them in compost. This problem occurs mostly when the organic material is not completely broken down.

MATERIALS

Four flower pots or cups with drainage holes
Gravel for drainage
Compost
Perlite
Seeds (bean, pea, radish, or lettuce seeds work well)
"Growing Plants With Compost Record"
Pencil, scraps of paper or cardboard

PROCEDURE

1. Put one inch (2.5 cm) of gravel in the bottom of each of the flower pots. Label the pots 1 to 4.

2. Add compost only to pot 1.

3. Using a measuring cup or other plastic cup, measure one part compost and an equal amount of perlite. Mix the compost and perlite together thoroughly. Fill pot 2 with this 1-to-1 compost-to-perlite mixture.

4. Using a measuring cup or other plastic cup, measure one part compost and three parts perlite. Mix the compost and perlite together thoroughly. Fill pot 3 with this 1-to-3 compost-to-perlite mixture.

5. Fill pot 4 with 100 percent perlite.

6. Plant three to four seeds of the same species in each pot. Bean seeds are fast growing and easy to observe.

7. Water your seeds following the instructions on the package. Make sure you add the same amount of water to each pot.

8. After four or five days, your seeds should have sprouted. Count the number of seeds that have sprouted in each of the four pots. Record the number of seeds that have sprouted. Thin the extra plants so you have one plant in each pot.

9. Follow the growth of your plants for four to five weeks. Once a week, measure the height of the plant in each pot. Record the height of the plants. Note if any plants die.

10. After five weeks, count the number of surviving plants. Compare the number of surviving plants in the different mixtures of compost and perlite. Then measure the height of the plants.

NOTE: To be more scientific, you may want to have more than one pot for each of the four compost "treatments".

EXTENSIONS

Repeat the experiment with a different kind of compost (vermicompost or backyard compost) and note any differences.

This experiment can also be done in a garden bed by mixing different measured amounts of compost into the soil and planting the same seeds in each bed.

Included with permission from: Composting: Waste to Resources, by Jean F. Bonhotal & Marianne E. Krasney
A Cornell Cooperative Extension Publication, Cornell University, Ithaca, NY 14850, (607) 255-5830

Growing Plants With Compost

Name: ____

Plant species: ______________________ Date planted: ______________

Sprouting *Pot Number*	*Plant*	*Date*	*Number of Seeds Sprouted*
1			
2			
3			
4			

Growth *Pot Number*	*Plant*	*Date*	*Height*
1			
Pot Number	*Plant*	*Date*	*Height*
2			
Pot Number	*Plant*	*Date*	*Height*
3			
Pot Number	*Plant*	*Date*	*Height*
4			

LANDING IN A NEW LAND

DESCRIPTION

Students are given a seed and must apply their knowledge of what plants need to survive in choosing where to plant a seed. Students draw treasure maps locating where the seed is planted and check the seed's growth weekly.

OBJECTIVE

Students will learn to see and think holistically when observing a landscape. Students will explore different micro-climates evaluating them for the amount of sunlight, water, soil fertility, and protection from humans, animals, and the elements. Students will have an opportunity to observe a correlation between naturally deposited organic material, and soil fertility.

GRADE

3-7

TIME

One class period and weekly check-ins.

MATERIALS

At least three soil samples
Seeds (radishes, garlic cloves, and beets are easy to grow)
Paper and pencils for drawing maps
Journals

DISCUSSION

Fertile soils are found where there is a lot of deposited organic matter. This usually means underneath plants where dead leaves and wood have accumulated or along creek beds and flood plains where organic material has been washed down stream. Soils with little organic material tend to be low in fertility.

Organic material provides food for decomposers living in the soil who in turn make nutrients available to plants. Fertile soil is just one of the things plants need. They also need sunlight, water, and protection. Take a walk around the school yard or a local park. If you were a seed, where would you choose to land for a good start in life?

PROCEDURE

1. Bring in soil samples or observe different soils in the school yard or local park. Find a humus soil, high in organic matter, a soil with a medium amount of organic matter, and a dead soil or one with very little organic matter. Have students begin to identify what a fertile, high organic matter soil looks, smells, and feels like.

2. Have students identify other things plants need to survive (sunlight, water, air, and protection).

3. Have students work individually or split the class into small groups of four or five.

4. Go to a fairly large outside area where students will be able to plant seeds. The school grounds or local parks are good choices.

5. Read the script to students.

TEACHER SCRIPT

"Imagine that you are explorers on a new continent. The plants and animals look strange and unfamiliar to you. You have not seen human inhabitants and have no idea whether the humans, if they exist, will be friendly. You have enough food stores for one season and a limited supply of seeds for planting. It is crucial that you recognize the characteristics of soil fertility and test areas likely to support a crop. Within the given boundaries, each scout or scouting group will be given two seeds to plant in the same spot, two to three times the depth of the seed. Specific characteristics such as soil fertility, amount of sunlight throughout the day, water availability, and protection from animals, and the elements, will all be recorded. Each site will have a map that leads to it and sites will be monitored and information recorded weekly."

6. Give students boundaries (that they must stay within) and a sound (either a whistle blow or a call) to signal them when to return.

7. Give each student or each group, two seeds to be planted in the same hole, a pencil and drawing paper.

8. Give students 15-20 minutes to plant their seeds and draw a map, marking where the seeds are planted.

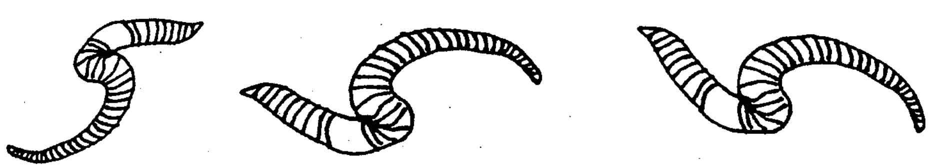
9. Using their maps, students locate and observe their seeds weekly. Students draw conclusions regarding plant growth and the environmental conditions that the seeds were planted in.

EXTENSION

Different groups can share their data and create a map of the entire area showing which spots could support a crop and why.

FUN FACTS ABOUT REDWORMS

1. Redworms eat the same things we do.
2. Redworms can eat over half their weight in food a day.
3. Redworms have amazingly similar blood to ours. Their iron-rich hemoglobin serves the same oxygen-carrying function as ours does.
4. Redworms breathe through their moist skin. Gaseous oxygen from the air diffuses through their skin, moving from a region of greater concentration (the air) to a region of lesser concentration (inside the worm). Carbon dioxide produced by the bodily processes of the worm also diffuses through the skin, moving from a higher concentration (inside the worm) to a lower concentration (the air).
5. Redworms have no eyes and cannot see but they use light sensitive skin cells, concentrated at the front end of their body, to sense light and move away from it.
6. A redworm's mouth has a small sensitive pad of flesh, called the *prostomium,* that protrudes above it's mouth and stretches out to sense suitable food particles.
7. Redworms have no teeth. They use their highly muscular mouth, pharynx and gizzard to break up food particles.
8. Redworms will not reproduce by being cut in half. Depending on where the worm is cut, the front part may grow a new tail but the tail can never grow a new head.
9. Redworms are hermaphroditic, meaning that all adult redworms have both male and female reproductive parts.
10. Redworms reach adulthood and can have offspring in 4-6 weeks.
11. Adult redworms can each produce 2-3 cocoons per week for six months to a year.
12. Baby redworms take 3 weeks to develop in a cocoon before they hatch. Two to three baby redworms hatch out of each cocoon.
13. It is estimated that eight adult redworms could produce 1,500 offspring within six months.
14. In the wild most redworms live and die within the same year. In a worm culture an individual redworm has been kept alive for four and a half years.
15. It is estimated that in the favorable conditions of the Nile Valley, earthworms deposit over 1,000 tons of nitrogen-rich castings per acre, per year.



Information taken from *__Worms Eat My Garbage__* *by Mary Applehof, Flower Press, (1982)*

HOW BIG A WORM BIN?

Worm Bin Math

DESCRIPTION
Students collect their lunch food scraps for two weeks to generate data necessary to estimate what size worm bin they will need.

OBJECTIVE
Students will use math calculations (counting, addition, subtraction, multiplication, division, fractions, decimals and ratios) and measurements (inches, percentage, gallons, pounds, and square feet) at a basic level to estimate what size worm bin they will need. Older students can do comparison shopping to determine the most effective and economical way to build or buy the right size bin or bins.

GRADE
3-6 (can be simplified for younger students and extended for older ones)

TIME
Two-week project

MATERIALS
1 five-gallon plastic bucket with lid
1 permanent marker or roll of tape
1 bathroom scale

BACKGROUND INFORMATION
Red worms are surface feeders and prefer living in shallow containers. For this reason the square footage of the base of the container is more important than the volume, in determining the size of your worm bin.

The standard measurement used when sizing a worm bin is:
1 sq. ft of surface area per lb. of food per week

PROCEDURE

1. Xerox the worm bin math worksheet. Have students work on it in teams or individually.
2. Have students measure and divide the five-gallon bucket into five equal sections. Make a line with the marker or tape all the way around the bucket at each section.
3. Label each section using a fraction, a percentage, and a gallon measurement.
4. Have students collect lunch scraps (except meat and dairy products) for two weeks.
5. After two weeks record the number of gallons of food in the bucket. Weigh the food by having a student hold the bucket and stand on a bathroom scale. Weigh the same student holding an empty bucket; subtract and record the weight of the food.
6. Point out to students that you now have a "by volume" measurement—gallons, and a "by weight" measurement—pounds. The relationship between volume and weight changes with the density of the material being measured.
7. Have students divide the total weight of the food by two to come up with "pounds per week".

How Big A Worm Bin?

3. After you have collected food scraps for two weeks, record the number of gallons of food and find out how much the food weighs.

   We collected ________ gal. of food.

   To find the weight of the food:

   a. Weigh yourself on a bathroom scale holding the bucket of collected food. __________ lbs

   b. Weigh yourself holding the same size empty bucket. ____________ lbs.

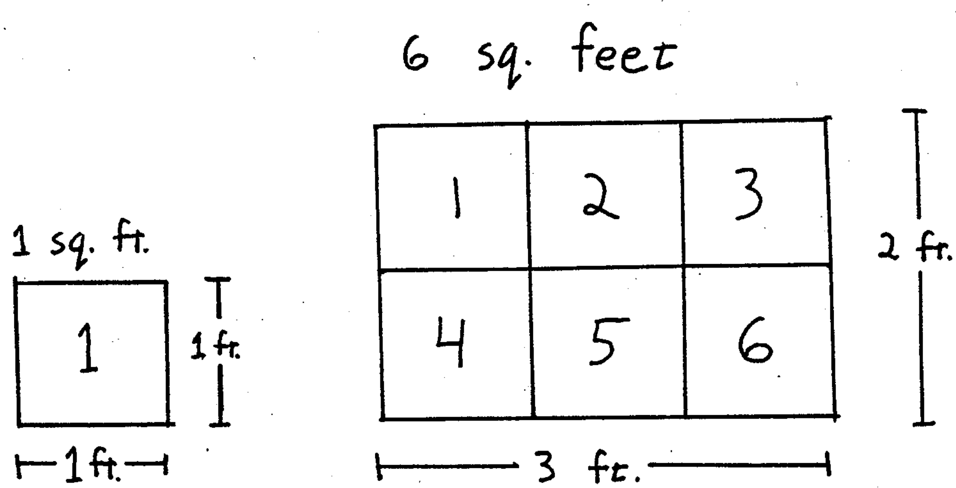
   c. Subtract (b) from (a) to get the number of pounds of food collected in two weeks ____________ lb.

4. To find the number of pounds of food you will need to compost each week divide:
   ________ lbs. of food ÷ 2 weeks = ________ lbs. each week

5. In this study we could say that _______ gals. of food weighed __________ lbs.
   This number will change depending on how dense the material in the bucket is.
   The bucket could be filled with three gallonsof watermelons or three gallons of potato chips.
   Which would weigh more?

   Why?

6. Now that you know how much food you will need to compost each week, you can figure out how many square feet of surface area the base of your worm bin needs to be. To understand how large a square foot is, on a piece of paper, measure a square that is 12 inches on each side. Cut this square out. It is one square foot. For each pound of food you compost each week, you will need one square foot of space on the bottom of your worm bin.



7. The ratio or proportion of pounds of food to the surface area of the bottom of the bin is one to one. This is written 1 lb food : 1 sq. ft. of surface area.

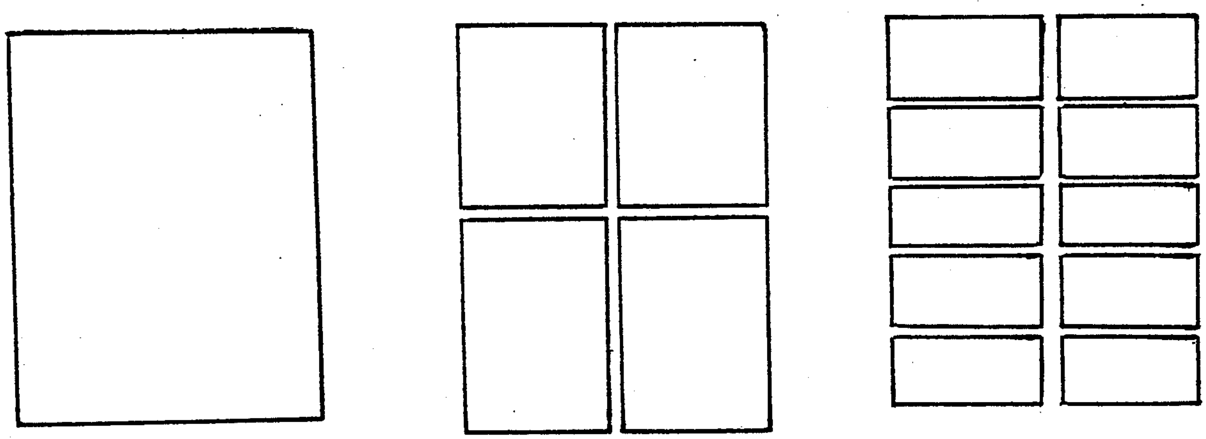
If you have __________lbs. of food each week, you need a worm bin with a bottom of at least_________ sq. ft.

8. If you know how many square feet you need for the base of your classroom's worm box, you can multiply this number by the number of classrooms in your school to estimate how large of a worm bin the whole school would need.

________ sq. ft. for our class x ________classes in our school =________sq. ft. for the base of a worm bin for the whole school.

9. If you need __________sq. ft. for the bottom of the worm box for the whole school, would it be better to have:

1 large bin **several medium bins** **or** **many small bins?**



Why?

WORM BIN CHECK–UP

CIRCLE THE CONDITIONS THAT YOU FIND IN YOUR COMPOST.

1. Moisture

puddles of water   liquid dripping from drain holes   worms have glistening skin

bedding is dry   casting and bedding stuck to worms   ants in bin

2. Decomposition

food still looks fresh   food is black and slimy   fuzzy mold on food

bedding is disappearing   castings are piling up   only the fiberous food is left

3. Reproduction

few red worms present   few baby red worms   many baby red worms

worms joined together mating   How many worm cocoons do you see? _____

I see _____ worms with a band (the clitellum) around them.

4. Air Circulation

bin smells rotten   food and bedding are matted in large clumps   puddles in bin

a few areas smell rotten   spaces can be seen in between bedding

bin smells fresh and earthy like the forest

5. Other Decomposers

How many other types of decomposers besides red worms can you see? ______

little white worms   slugs or snails   sow bugs

fruit flies   ants   mites

others ________________   ________________

________________   ________________

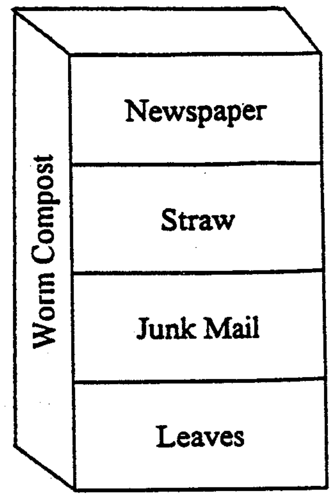
BEDDING BETS

DESCRIPTION

Students test different bedding materials in their worm compost and make bets or predictions on which ones the worms will prefer and why.

OBJECTIVE

Students will discover the characteristics of different bedding materials. Students will observe which bedding materials worms thrive in. Students will collect data to help them extrapolate why the worms prefer one bedding over the other.



GRADE

3 and up

TIME

On-going project (at least two months)

MATERIALS

One large or four small
worm compost containers
Red worms
Food scraps
Shredded black and white newspaper
Straw
Shredded junk mail
Dead leaves
Journals

PROCEDURE

1. Set up one large or four small worm composts using different bedding materials.
2. Keep all other environmental conditions as constant as possible.
3. If using one large worm compost, divide the container in fourths by thumb tacking string across the top. Use different bedding materials in each section.
4. If using four smaller containers, set each up with a different bedding material.
5. Add an equal amount of food and worms to each bedding.
6. Feed each bedding section equal amounts and at the same time.
7. Check and compare the results weekly.
8. Record findings in journals.
9. At the end of the experiment draw some conclusions about which bedding material helps maintain the most favorable conditions for the worms and why.

BEDDING BETS RECORD

Week No. Example

Number Boxes from 1-4 1 Being the Best 4 Being the Worst	Newspaper	Straw	Junk Mail	Leaves
Number of worms	1	3	4	2
Number of cocoons	2	3	4	1
Decomposer	2	4	3	1
Moisture balance — wet but no puddles	1	4	2	3
Number of worms with a clitellum (the band around their body)	1	2	1	3
Total Score (The lowest score is the best bedding; the highest score, the worst)	3	4	5	6

BEDDING BETS RECORD

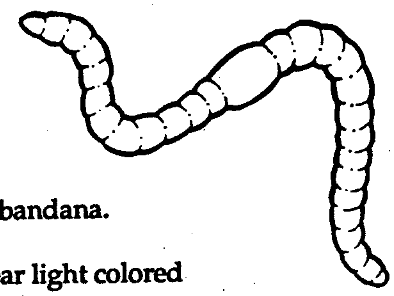
Week No.___________

Number Boxes from 1-4 1 Being the Best 4 Being the Worst	Newspaper	Straw	Junk Mail	Leaves
Number of worms				
Number of cocoons				
Decomposer				
Moisture balance — wet but no puddles				
Number of worms with a clitellum (the band around their body)				
Total Score (The lowest score is the best bedding; the highest score, the worst.)				

DECOMPOSER TAG

DESCRIPTION Students play a freeze tag game where death tries to tag and freeze the nutrients in plants and animals. The decomposers unfreeze the nutrients trapped in dead bodies, allowing them to return to the cycle of life.

GRADE 2-6



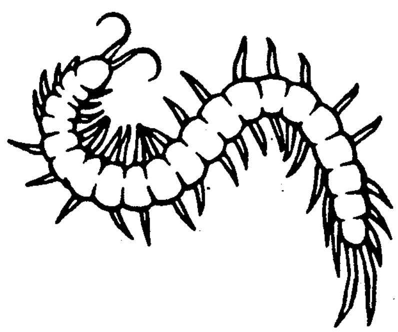
TIME 20-30 minutes

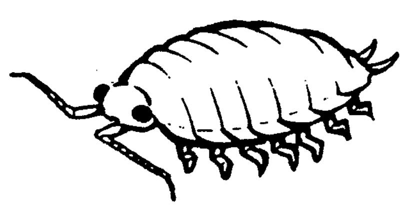
MATERIALS Two light colored and one dark colored bandanas

PROCEDURE

1. One student is death and wears a dark colored bandana.
2. Two to three students are decomposers and wear light colored bandanas. All other students are plants or animals.
3. Death kills plants and animals by tagging them. If plants or animals are tagged, they are frozen in place until one of the decomposers unfreezes them by running around them three times. The decomposers unfreeze the plants and animals as fast or faster than death freezes them.
4. The game has no natural end. You should let students play long enough to experience the concept, and stop the game well before students get exhausted and/or lose interest.

VARIATION To demonstrate that life would stop without decomposers recycling dead things, you can allow "Death" to tag and freeze the "Decomposers" along with the plants and animals. The game, and life on Earth, ends when everyone is frozen except "Death".





I CAN COMPOST...

DESCRIPTION

In this game students call out something they can compost before the person in the middle tags them. This game can be played indoors or outdoors.

OBJECTIVE

Students review what they can compost.

GRADE

1-8

TIME

20 minutes

MATERIALS

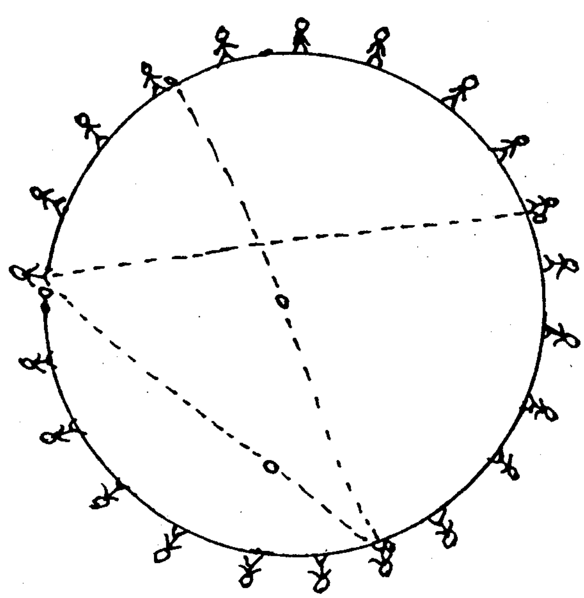
A Koosh ball or other object to toss.

PROCEDURE

1. On the board or in their journals, students list as many items as possible to compost.
2. To start the game everyone stands or sits (if indoors) in a circle.
3. A person calls out something that can be composted and the person's name who the Koosh ball (or any other appropriate object) is being tossed to.
4. Once students get the hang of it, put someone in the middle of the circle, whose goal is to tag the person with the ball before it is tossed. If tagged, that person changes places with the one in the middle.
5. To make sure all the students get a turn, students can sit down after they have named something they can compost and tossed the ball to another student.

EXTENSION

A song, rap or poem can be created out of the list of what can be composted.



WORMS AND BACTERIA

DESCRIPTION

Students play an outside tag game as a fun way to do a kinesthetic, true or false, comprehension check.

OBJECTIVE

Students will distinguish between true and false questions and have the opportunity to correct misconceptions regarding composting.

GRADE

2-8

TIME

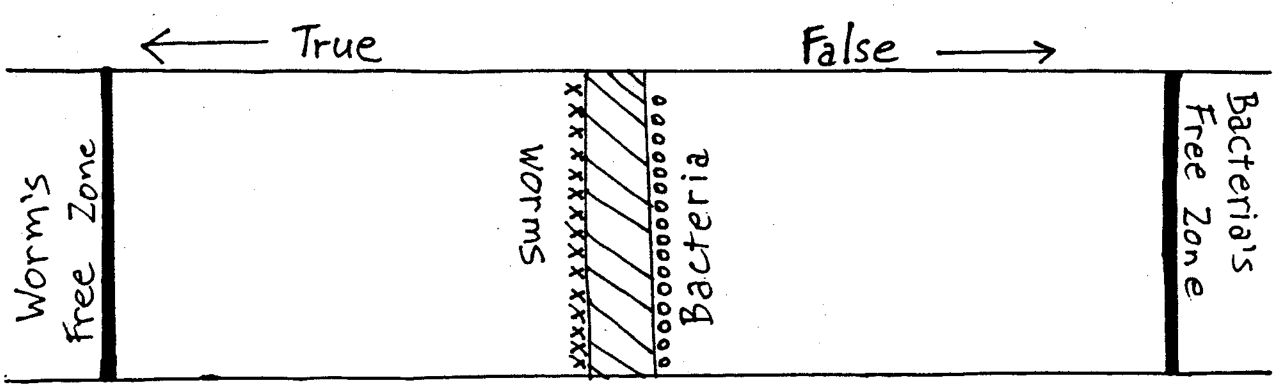
20-30 minutes

BACKGROUND INFORMATION

Listed on the next page is a sample of 40 true and false statements regarding backyard and worm composting.
When reading the questions, intersperse true and false questions.
Choose questions from this list that your students covered and add questions of your own that you think they should know.

PROCEDURE

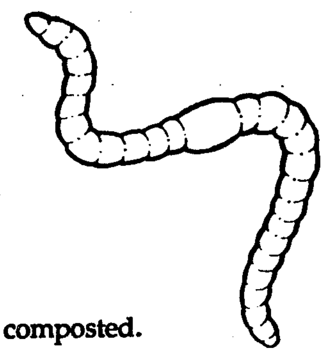
1. Set up the playing field, to match the diagram.
2. To start the game, divide the group in half. The bacteria stand on their line, and the worms on theirs, with a five-foot space in-between.
3. Read a true/false statement aloud. Students decide if the statement is true or false. If it's true, the worms turn around and run to their free zone with the bacteria chasing them and trying to tag them. If the statement is false, the bacteria turn and run to their free zone with the worms trying to tag them.
4. Anyone tagged becomes part of the group who tagged them.



Worms And Bacteria

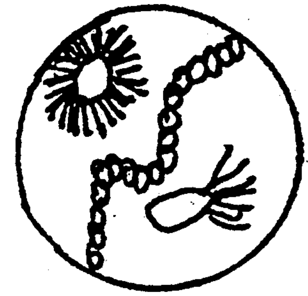
TRUE AND FALSE QUESTIONS

True



1. Organic material is anything that was recently living.
2. Red worms can eat 1/2 their weight in food a day.
3. Wood is an organic material.
4. Worms need both air and water to survive.
5. Decomposition occurs in nature.
6. Finished compost and humus are the same material.
7. Finished compost is basically excrement from decomposers.
8. Composting is nature's method of recycling.
9. Bones, meat, and dairy products tend to attract rodents and should not be composted.
10. Humans are made out of organic material and when dead, decompose.
11. Without decomposers, life on Earth could not continue.
12. Plants are the only living things that produce food from inorganic substances.
13. Compost improves soil structure and provides nutrients for plants.
14. Decomposers could survive without humans, but humans could not survive without decomposers.
15. Bacteria need a combination of carbon rich and nitrogen rich materials.
16. Red worms are neither males nor females but both.
17. If your compost smells bad, it needs more air.
18. Compost piles can reach 150° F.
19. Herbivore manures can be composted.
20. The heat given off by compost piles is converted sunlight. (*Bonus question)

False



1. Plastic will decompose quickly and should be composted.
2. Used motor oil should be poured into your compost.
3. Compost always smells bad.
4. Cheese is one of the best things to compost.
5. Worms like sunlight.
6. Paper will not decompose.
7. Ice cream should be put in compost piles.
8. All organic material decomposes at the same rate.
9. Compost piles should be kept as dry as possible.
10. Heat from compost piles primarily results from the sun warming them.
11. Worms are the only decomposers in a worm compost.
12. Meat and bones are inorganic and will not decompose.
13. Composting was invented a few years ago to solve our landfill crisis.
14. Leaves and newspaper are inorganic, therefore they can be used for bedding in a worm compost and won't be eaten.
15. Organic material decomposes fastest at temperatures near freezing.
16. Larger pieces of organic material decompose first.
17. Decomposers break organic material into smaller pieces, but they don't eat it.
18. All decomposers can be seen with the naked eye.
19. Healthy farmland has very few bacteria in the soil.
20. Decomposition occurs on land but not in the ocean. (*Bonus question)

WHO EATS WHO?

DESCRIPTION Students are introduced to the concept of nutrient cycling.

OBJECTIVE Students must arrange cards, representing different parts of a nutrient cycle, in the order that energy (food) flows through an ecosystem.

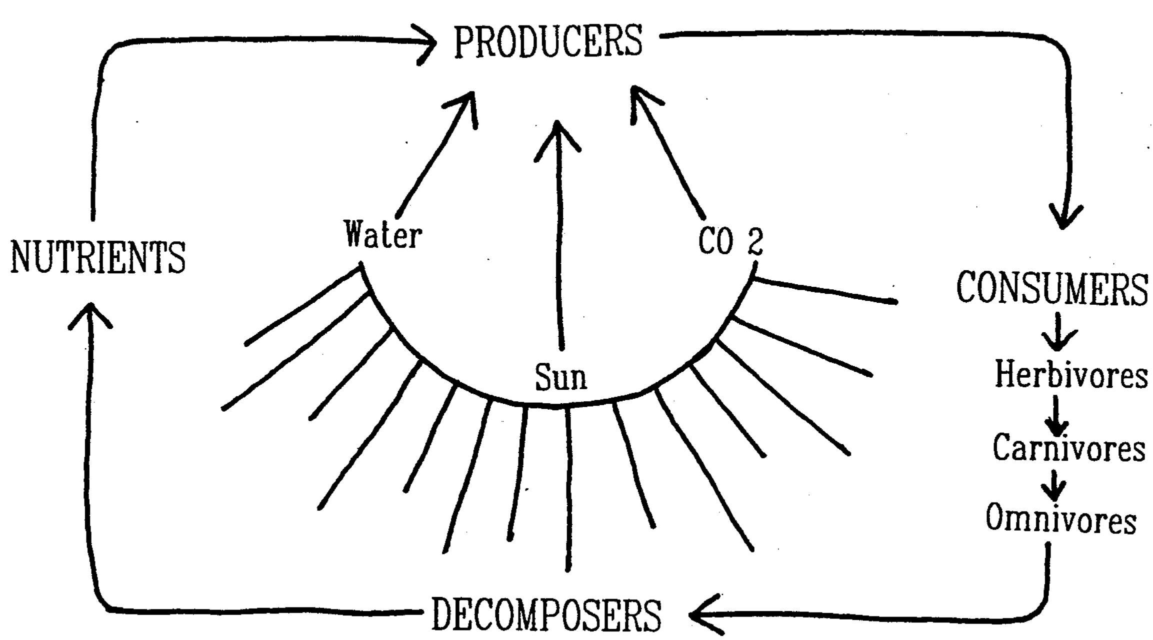
GRADE 2-6

TIME One class period

BACKGROUND INFORMATION Plants are termed producers because they are the only organisms that can synthesize food energy from inorganic substances. Plants convert sunlight, water and carbon dioxide into simple sugars. This process is called photosynthesis. Animals cannot produce their own food. They are called consumers because they have to consume food from an outside source. There are three levels of consumers: herbivores or plant eaters, carnivores or meat eaters and omnivores who eat both animals and plants. Organisms that consume dead plants and animals are termed decomposers. Through digestion, decomposers convert the dead bodies of plants and animals into humus containing necessary plant nutrients.

MATERIALS Chalkboard

One set of energy flow cards per group. *To make a set of cards, include a picture or the written names of a type of producer (oak tree), herbivore (deer), carnivore (mountain lion), omnivore (racoon), and decomposer (earthworm) along with soil, water, sunlight and carbon dioxide.*



Who Eats Who?

DISCUSSION

Draw the skeleton of a nutrient cycle on the board. Students will help you fill in the information. Ask students where does food come from? Introduce photosynthesis and the idea that plants produce food. Fill-in "producer" on the diagram. Ask for examples of animals that primarily eat plants, primarily eat animals and eat both plants and animals. Fill-in "herbivore", "carnivore" and "omnivore" on the diagram, as these are three different kinds of consumers. Ask what happens when the producers and consumers die. Why aren't we tripping over dead dinosaurs? Ask for examples of animals who eat dead things. Fill-in "decomposer" on the diagram. The decomposers convert the dead bodies of plants and animals into humus, containing nutrients available to plants. Fill in "humus" as the last slot to complete the cycle.

PROCEDURE

1. Students are separated into small groups and given a packet of cards with pictures or the written names of a type of producer, herbivore, carnivore, omnivore and decomposer along with soil, water, sunlight and carbon dioxide.

2. Each group must arrange the cards in the proper order showing how energy flows through an ecosystem.

EXTENSION

Students can write a poem or song naming who eats who.

DIRT FOR LUNCH

DESCRIPTION Students track the food in their lunches back to the earth.

OBJECTIVE To illustrate that all our food comes from the earth and that healthy food depends on healthy soil.

GRADE 2-6

TIME One class period

BACKGROUND INFORMATION Many children do not understand that all of our food including animal products and processed foods originate from the earth.

MATERIALS Students' lunches
Journals

PROCEDURE

1. In their journals, have students list everything they are having for lunch.
2. Inform students that no matter what they have packed for lunch, ultimately they are eating dirt.
3. Challenge students to name a food in their lunches that did not come from dirt.
4. Help students figure out the ingredients in different foods and, as a class, trace each food's origin back to the earth.
5. Use a tuna fish sandwich for an example.

* The bread came from wheat grown in the dirt.
* Pickles are preserved cucumbers grown in the dirt.
* Lettuce was grown in the dirt.
* Mayonnaise came from eggs, that came from chickens, that ate grains grown in the dirt.
* Tuna living in the ocean, eat smaller fish, that eat zooplankton, that eat phytoplankton which needs nutrients from the decomposed bodies of dead plants and animals accumulated on the ocean floor and brought to the surface by currents.

EXTENSION Make posters and pins that say, "I EAT DIRT, ASK ME HOW".

THE LONG JOURNEY

DESCRIPTION Students examine modern farming, processing, packaging and transportation routes that much of their food goes through on its way from the ground to their lunches.

OBJECTIVE To explore the food supply system.

GRADE 4-Adult

TIME One class period

MATERIALS Students' lunches
Journals

DISCUSSION Over the last 50 years, changes in farming methods, processing and transportation have significantly effected our food supply. Much of our food goes through expensive processing, packaging and transportation before it reaches our table.

PROCEDURE Students list all the items in their lunch and analyze them by answering the following questions.

1. Who has a food with nature's packaging? (a skin, peel, wrapper or shell).

2. Who has food that came in one layer of packaging? Two layers? Three layers? More than three layers?

3. Is the amount of packaging on your food necessary? Why would the producer include extra packaging? Is any of the packaging produced from recycled products? Can any of the packaging be reused or recycled? How could you reduce the amount of packaging used? Where will the packaging end up?

4. Who is eating food they grew themselves? Food grown by someone they know? Food grown in the county? In the state? In the country?

5. What are the advantages of buying locally grown, seasonal food? What are the disadvantages?

6. Who is eating food imported from another country? What are some advantages of buying imported foods? What are some disadvantages?

7. How far did your food travel from the farmer to your table? Were there any in-between steps where your food went through processing?

8. What resources were used to transport, process, store or package your food?

9. What farming methods might have been used to transcend or manipulate natural limitations to food production? (for example, irrigation, genetically engineered varieties of crops, chemical fertilizers, pesticides, herbicides, irradiation, special packaging, refrigeration or special processing.)

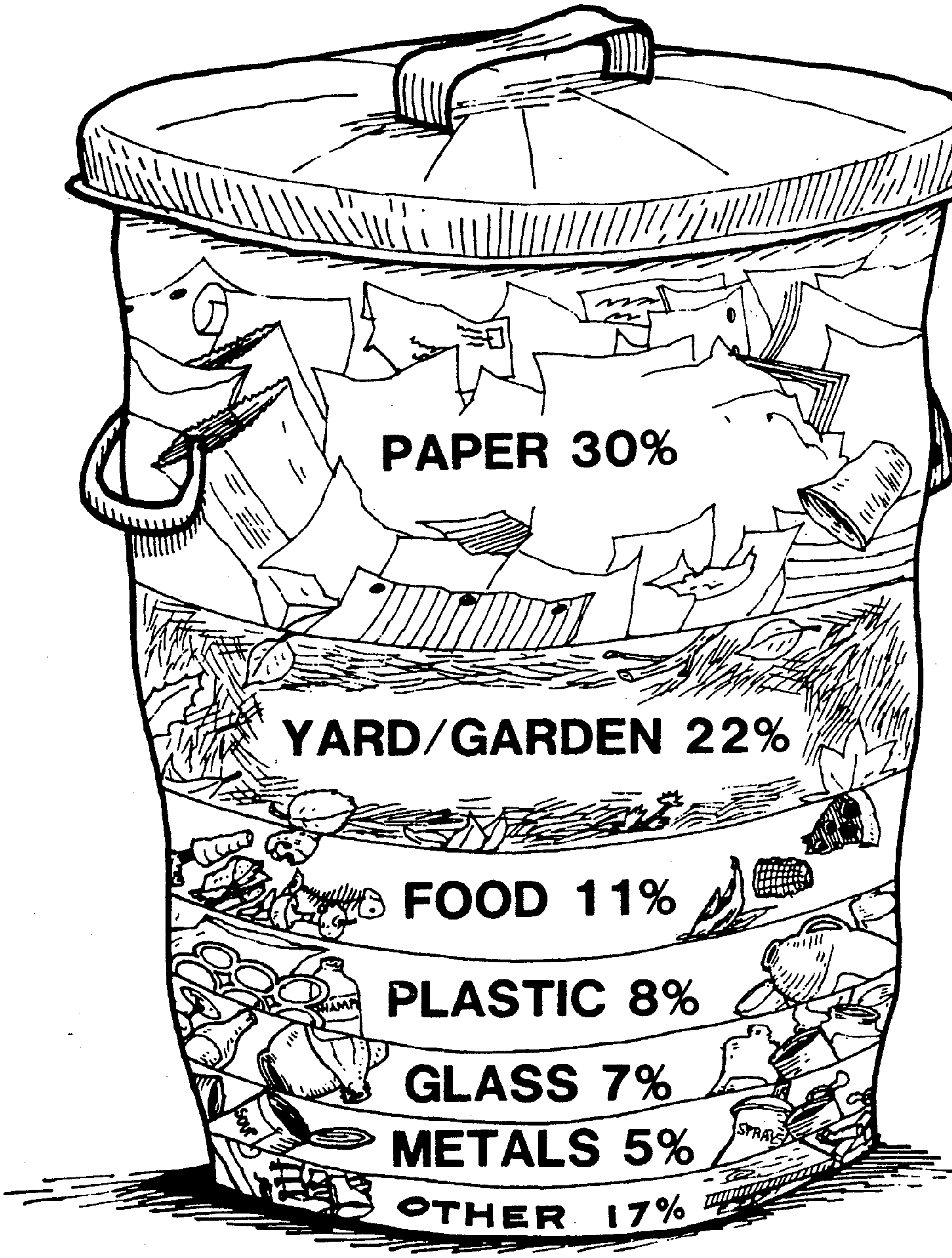
10. In many climates, winter has traditionally been a time with little fresh food available. How has this changed in the last 50 years? What methods were traditionally used to preserve and store food for the winter?

EXTENSION

Research the kind of food the native people in your area ate throughout the year. How did they transport their food? What processing or preserving methods did they use? What indigenous plants did they eat that you do not? What foods did they eat that you eat?

Research the kind of food your ancestors ate? How was their food transported, packaged, processed and stored?

What is Waste?



"A - Way With Waste." Washington State Department of Ecology
3190 160th. Avenue SE.
Bellevue, WA 98008
(206) 649-7043

DISPOSAL OF SOLID WASTE INFORMATION SHEET

BACKGROUND INFORMATION

Because solid waste is concentrated in highly populated areas, it must be removed quickly and efficiently to prevent health problems. In the past, dumps were used which were simply piles of uncovered waste. They attracted rodents and insects, and were unsightly, smelly and a health threat. Sanitary landfills replaced these dumps in the 1970's, but it was not until 1981 that the burial of hazardous wastes was banned in these landfills.

There are several methods currently in use for disposal of solid waste. These methods include landfills, incineration, and recycling. In the United States, 17.1% of solid wastes are recycled or composted, 16.3% are incinerated, and 66.6% are disposed of in landfills (U.S. Environmental Protection Agency, 1990).

LANDFILLS

When we "throw away" something, it does not just "go away" — most of it goes into a landfill. A sanitary landfill is a site where solid waste is disposed of on land to prevent public health and safety hazards. Landfills have strict guidelines for placement. They must be constructed in areas where the possibility of contamination of ground water will be minimal, with a series of pipes to remove leachate beneath a clay liner. Garbage must be compacted and covered with six inches of soil daily, and land must be reclaimed as landfill operations are completed.

Landfills are running out of room. Landfills are becoming "Landfulls". Each day, Americans throw away 400 million pounds of food, junk 20,000 cars, and discard 18,000 TV's. The United States has 5% of the world's population, but produces 30% of the world's garbage.

Leaks from landfills can contaminate ground water. These are called leachates, which are liquid wastes and can be formed when water mixes with buried waste. Leachates may contain a variety of hazardous materials, including household hazardous wastes.

Many of the materials buried are non biodegradable and will remain intact for centuries. Not only are the non biodegradables such as plastic unchangeable, but the things they contain, even though biodegradable, cannot be acted upon by decomposers and will also remain essentially unchanged for generations.

INCINERATION

Incineration (the burning of waste) reduces the amount of waste by about 30-40%. With recycling, incineration can at best reduce the amount of waste by about 80%. Incinerators can also be used to produce electricity, by generating steam with the burning waste, and using the steam to turn turbines. There are concerns about the need for air pollution controls to keep particulate matter from escaping into the air. Also, the ash remaining must be buried in a landfill, and this residue often contains toxic metals and dioxins, which are classified as hazardous wastes.

Disposal of Solid Waste Information Sheet

RESOURCE RECOVERY

Natural resources contained in wastes are growing more limited and more expensive. We can no longer afford to waste energy or to discard valuable resources that are still usable.

THE THREE R's + C

Reduce. Everyone can help reduce the amount of waste produced in this country. Buy products that last longer, and only buy the amount of a product needed for the job. Support businesses that use less packaging.

Reuse. Reuse products instead of buying new ones, and swap with others, products that are no longer being used.

Recycle. Take paper, cardboard, glass, metals and, certain plastics, to recycling centers. (Batteries, used motor oil, paint and other household chemicals should be taken to a hazardous waste facility or a household hazardous waste collection.)

Compost. Yard trimmings and kitchen scraps can be recycled through composting, letting decomposer organisms turn these materials into humus.

Adapted with permission from: Washington State Department of Ecology, A Way With Waste, 3190 160th Avenue S.E. Bellevue, WA 98008, (206) 649-7043

OUT OF SIGHT, OUT OF MIND

DESCRIPTION Students use U.S. Environmental Protection Agency, 1990 municipal solid waste (MSW) statistics to generate their own trash statistics.

OBJECTIVE To visualize how much waste is generated for each person in the United States. To use math skills in calculating personal waste generation statistics.

GRADE 4-Adult

TIME One class period

MATERIALS
One trash can full of typical school trash
A scale
"Trash Math Worksheet"
A tarp

DISCUSSION Describe trash and list some examples. What qualities does an item have that makes you decide it's trash? What different kinds of trash are there?

PROCEDURE

1. Dump the full trash can onto a tarp. Sort through the trash. Estimate percentages of different materials such as paper, plastic, food etc.
2. Using the scale, weigh out 4.3 pounds of trash. Does this seem like a lot of trash? This is how much trash the average person in the United States generates each day.
3. In the year 1990, the U.S. generated 195.7 million tons of MSW. How do you think the number 4.3 pounds per person, per day was calculated? Will the number ever change?
4. A ton weighs 2000 pounds. To help you visualize how much a ton weighs, add the weights of students in your class until you reach one ton. How many students does it take to make one ton?
5. Using the E.P.A. statistics and your math skills, complete the trash math worksheet.

QUESTIONS What happens to all the trash you throw away? What do you think happens to waste at the landfill? What are possible problems with piling waste in landfills? What would you do with your family's trash if there was no truck that came to take it away? How might this affect the amount of trash your family makes? What could you do to reduce the amount of trash you make?

Adapted with permission from: Wisconsin Department of Natural Resources, Bureau of Solid Waste Information and Education, Box 7921Madison, WI 53707

E.P.A. STATISTICS

1. In the year 1990, 195.7 million tons of Municipal Solid Waste (MSW) was generated in the U.S., or 4.3 pounds per person per day.

2. 17% of the material was recycled or composted, 16% was combusted or incinerated and 67% was landfilled or otherwise disposed of.

3. After subtracting the materials that were composted or recycled, each person generated 3.6 pounds of MSW per day.

4. 55%-65% of the MSW comes from residences; 35-45% comes from commercial sources.

Figure ES-2. Management of MSW in U.S., 1990
(Total weight = 195.7 million tons)

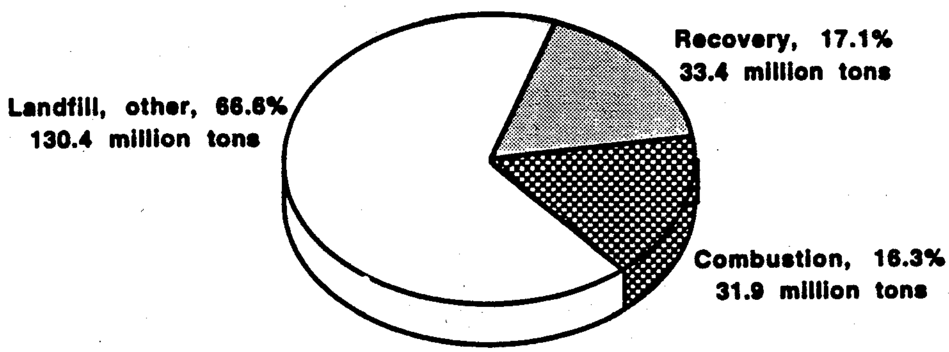
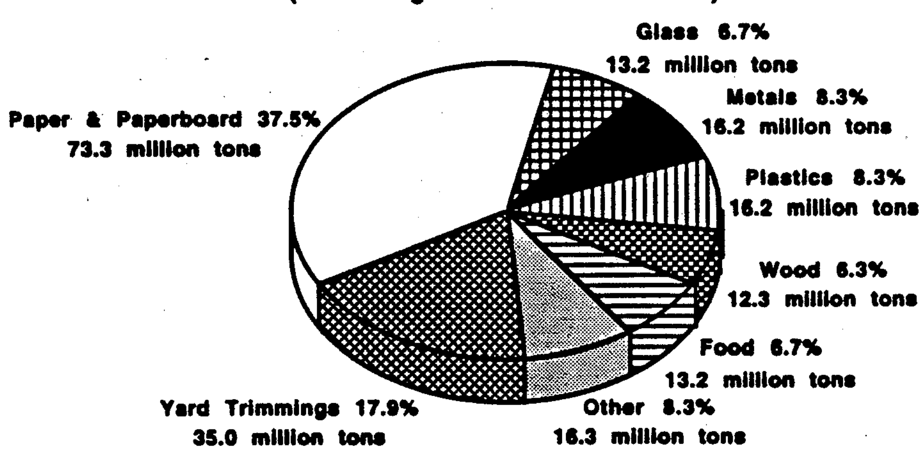


Figure ES-1. Materials generated in MSW by weight, 1990
(Total weight = 195.7 million tons)



TRASH MATH WORKSHEET

1. If you generate 4.3 pounds of trash each day, how many pounds do you generate every week? ____________

   Every month? ____________

   Every year? ____________

2. There are 2000 lbs in a ton. How many tons of trash do you make every week? ____________

   Every month? ____________

   Every year? ____________

3. How many people are in your family? ____________ How many pounds of trash does your family generate every week? ____________

   Every month? ____________

   Every year? ____________

4. Count the number of students in your classroom. ____________ How many pounds of trash does your classroom generate every day? ____________ How many tons does your classroom generate a day? ____________

   Every month? ____________

   Every year? ____________

5. How many tons of MSW was recycled or composted in 1990? ____________

   How many pounds? ____________

6. How many tons of MSW was combusted or landfilled in 1990? ____________

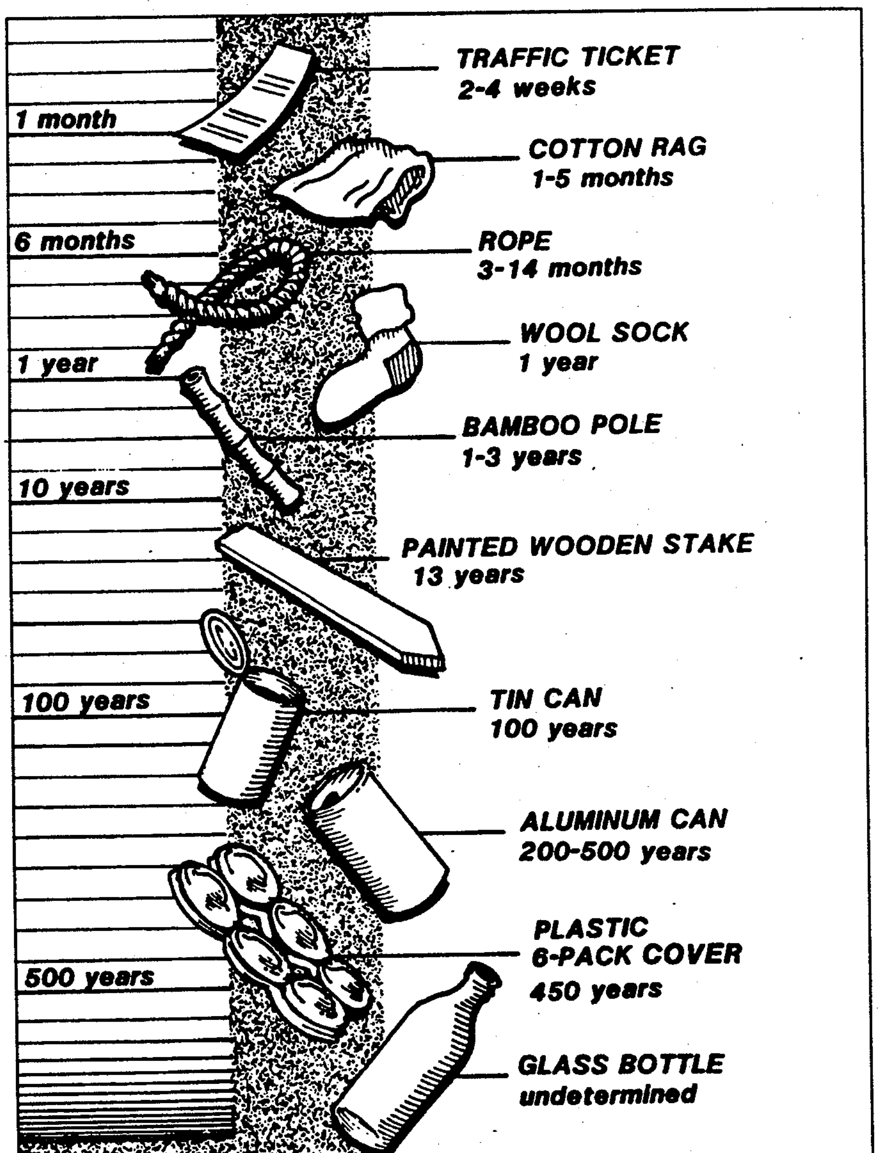
   How many pounds? ____________

7. If the U.S. composted 100% of its food waste and yard trimmings how many tons of waste could be turned into a valuable soil resource? ____________

8. What percentage of the total U.S. 1990, MSW is food and yard trimmings? ____________

ENDURING LITTER

Litter at the roadside is ugly. How long it will stay before decomposing may be an ugly surprise.



Taken from the "No Waste Anthology: A Teacher's Guide to Environmental Activities," California Department of Health Services Toxic Substances Control Program, Education and Information, PO Box 942732, Sacramento, CA 94234-7320 (916) 322-0476

IT'S NOT WASTE, UNTIL IT'S WASTED

DESCRIPTION

Students discuss the concept of waste, past and present. Students research attitudes and practices that Native Americans, living in the area before them, had regarding waste. Students interview senior citizens about what was considered waste when they were young and how wastes were managed.

OBJECTIVE

Students examine their perceptions of what makes something waste and what makes something a resource. Students realize that what is considered waste and what is considered a resource is dependent on culture and history.

GRADE

2-6

TIME

One class period, plus homework research

DISCUSSION

What is "garbage"? What do we mean when we say garbage? Have the students suggest all of the things that they think are garbage and write them on the chalkboard.

Is garbage everything that we throw away? Or can we use some of the things that we throw away?

What happens to your garbage once it gets picked up from your house? Where does the garbage truck take it? Does everybody's garbage go to the landfill? What will happen when the landfill is full?

RESEARCH QUESTIONS

What did the Native Americans who lived in your region before you do with their trash? What would they consider trash? How much garbage did they produce? How did their lifestyle and attitudes reflect what they considered garbage?

Do you think Native Americans today have different types of garbage than their ancestors?

What kind of garbage did your great grandparents produce when they were kids? What did they do with their garbage? How did their attitudes and lifestyles effect their view of garbage?

Interview senior citizens and ask them the following questions:

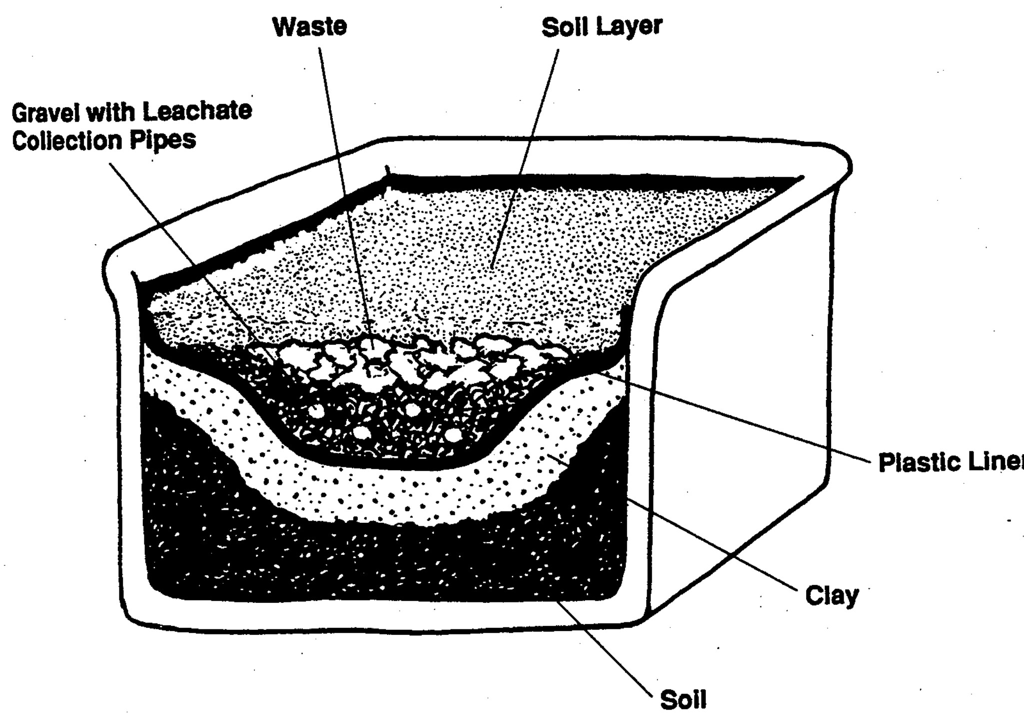
1. Did they produce more or less garbage when they were kids?
2. What were their toys made of ? What did they do with broken toys?

3. What did they take to school for lunch? How was it packaged?
4. What did they do with their garbage? Did a trash truck pick it up from their house?
5. In stores how was meat, milk, produce and grains packaged?
6. What did people use before their was plastic?
7. When did they consider something garbage?

EXTENSION

Build a mini sanitary landfill in a terrarium or large glass-bottomed box. Place a variety of wastes (metal, food, paper, plastic) onto the gravel, and cover with a light layer of soil. Sprinkle occasionally with water to simulate rain. Observe changes in the waste materials over time and watch for leachate collecting at the bottom.

"BATHTUB" Model of Modern Sanitary Landfill



Adapted from: Alameda County Home Composting Education Program, 7977 Capwell Dr., Oakland, CA 94621 (510) 635-6275 and The U.S. Environmental Protection Agency "Let's Reduce and Recycle: Curriculum for Solid Waste Awareness," OSW Publications, Office of Solid Waste, U.S. Environmental Protection Agency, 401 M Street SW, Washington, DC 20460, 1-800-424-9346

LUNCH LEFTOVERS: DON'T TRASH THE EARTH

DESCRIPTION
Students save and sort trash from their lunches and brainstorm ideas for reducing the amount of trash they create.

OBJECTIVE
To learn that conserving resources and reducing waste is necessary if we are to live on Earth sustainably.

GRADE
4-adult

TIME
One class period

MATERIALS
4 boxes, labeled PLASTIC, PAPER, RECYCLABLES, and FOOD WASTE
A tarp

PROCEDURE

1. Students separate their lunch trash into four boxes, labeled PLASTIC, PAPER, RECYCLABLES, and FOOD WASTE. Most students are not experienced trash sorters. Questions such as, "Is this paper or plastic?" are often asked. Use these opportunities to let students discover what materials are used in packaging.

2. Check boxes, making sure trash was properly sorted.

3. Turn over each box onto the tarp, creating a plastic, paper, and recyclables pile. (Do not dump the food waste box, as it would be very messy.) Collecting and sorting the trash provides a dramatic visual presentation, showing the amount and kinds of trash one group creates in a single lunch.

4. Ask students to multiply each pile by five representing the amount of lunch trash produced by the class in one week.

5. Multiply this number by 33 to represent the number of weeks in a school year.

6. Multiply this number by the number of classes in their school; the number of schools in their town, county, state, or country.

7. Introduce the Reduce, Reuse, Recycle hierarchy. Reducing the amount of packaging is best. Reusing a package is second best, and recycling is preferable to land filling.

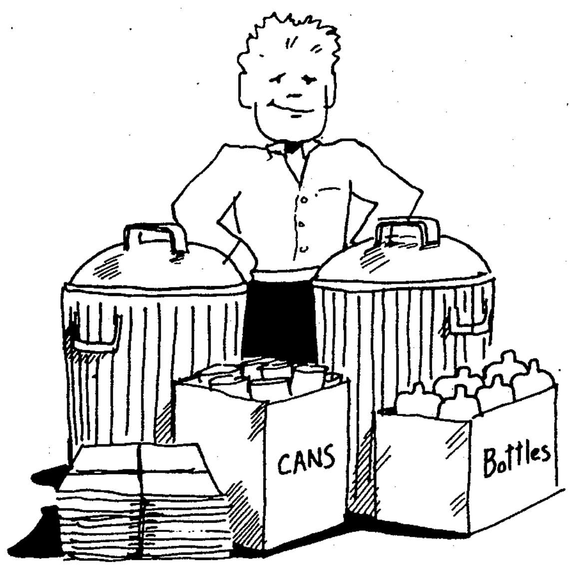
8. Composting food and yard wastes keeps materials out of landfills and turns organic wastes into a rich soil amendment.

9. Working in small groups, students brainstorm ideas for reducing the amount of lunch trash they create.

10. A spokesperson from each group shares ideas with the class. A scribe writes down ideas as they are shared. A list of ways to reduce lunch trash can be posted and shared with others.

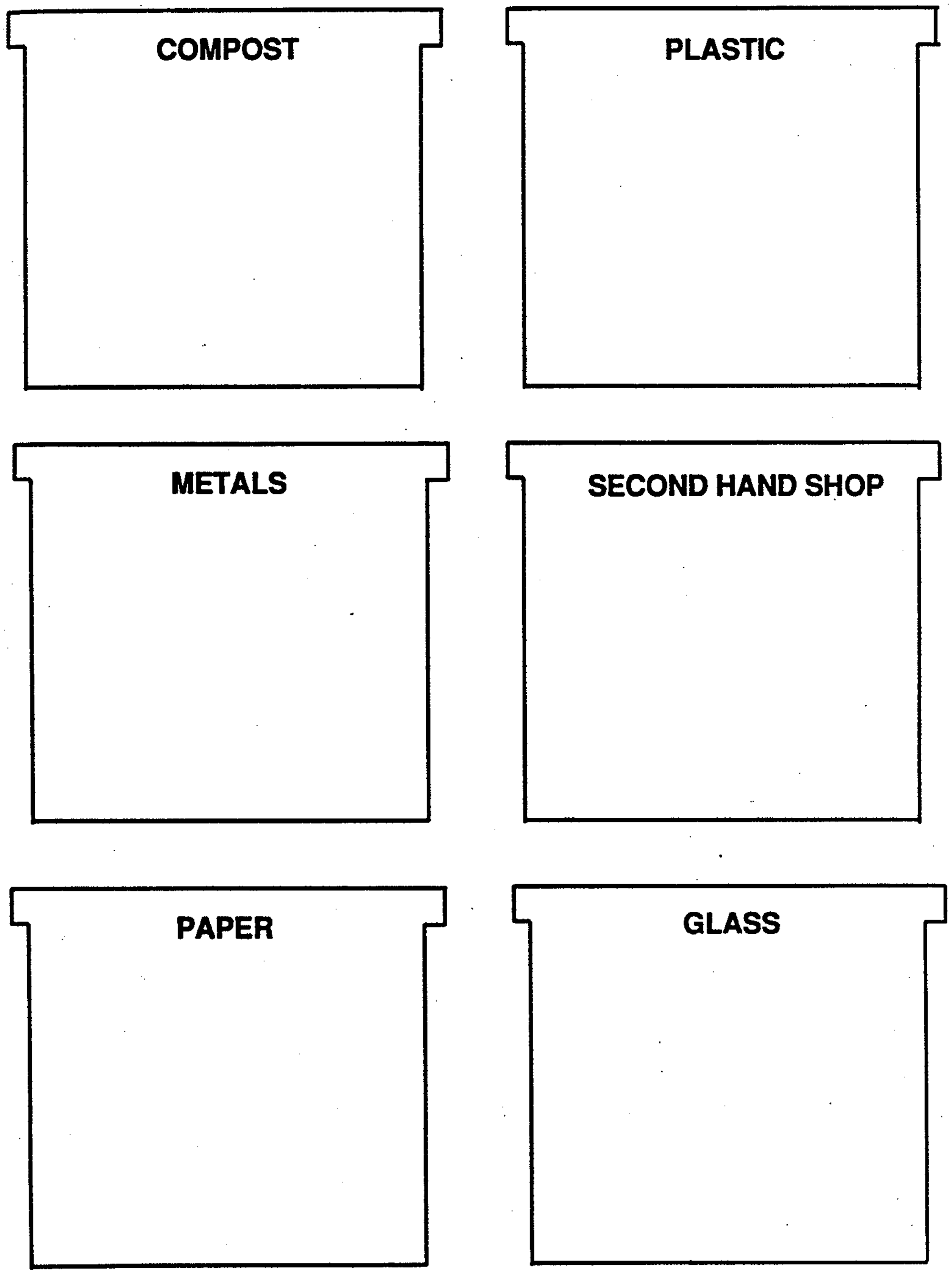
EXTENSIONS

Research what kids 100 years ago had for lunch and the kind of lunch trash they generated. Research indigenous cultures around the world. How do they package their lunch? What trash results? What do they do with the trash?



SAVE! SORT! RECYCLE!

Color the recyclables in the boxes on this page. Then cut them out and paste them into the proper recycling bins on the next page.



"Let's Reduce and Recycle: Curriculum For Solid Waste Awareness." United States Environmental Protection Agency Office of Solid Waste, Publications, Attn:. Curriculum, 401 M Street, Washington, DC 20460, 1-800- 424-9346

TOWN MEETING
WHAT TO DO WITH OUR WASTE?

DESCRIPTION

Students will simulate a public hearing where different options are considered for solving the community's problem of shrinking landfill capacity. Students will role play different interest groups in the community, expressing their opinions and voting from the position of their interest groups.

OBJECTIVE

Students will realize that there are many perspectives and no one right answer. Students will experience a democratic interdisciplinary approach to community decision-making.

GRADE

3-Adult

TIME

60-90 minutes

MATERIALS

Interest group cards or pieces of paper with the name of each interest group written on them.

A list of the proposals written on the board or a large piece of paper

Paper and pencils for interest groups to write their statements.

©Wiggly Worm

PROCEDURE

1. The teacher or other adult should play the mayor and facilitate the meeting.
2. The mayor reads the opening statement and list of proposals, under consideration.
3. Divide the class into seven groups.
4. Pass out an interest group card to each group. (For older students, you may want to just give students the name of their interest group and let them figure out what their interests would be.)
5. Explain that students are now members of their interest group in the community, and that they should discuss the issues and how the different proposals put forth would effect them.
6. Each group should come up with a statement regarding their concerns, interests and which plan or plans they support and three reasons why.
7. Each group should choose a spokesperson who will deliver the group's statement and answer questions.

8. Have the spokespersons from each group sit at the front of the classroom facing the audience. One at a time, spokespersons should state which group they represent, deliver the group's statement and take three questions (or more if you have time) from the audience.

9. With students still part of an interest group, take a secret vote to decide which plan the community will choose.

10. Take another vote with students voting as themselves.

DISCUSSION

After the vote, students can discuss what it was like to play a role that may or may not have reflected their own values. Students can compare their simulated public hearing and decision-making process with real public hearings in their community. Discuss what issues in your community are up for public hearing. Students can observe and/or participate in a real public hearing at city council or county board meetings.

TEACHER SCRIPT

OPENING STATEMENT

"I would like to welcome the citizens and friends of our fair town, Whaler's Cove, to this public hearing. Like many communities, we are anticipating a garbage crisis. At the current rate of generation, our present landfill, the Whale Bone, will reach capacity in five to seven years. As you know Whaler's Cove is located near the ocean, has a population of 50,000 people, is known for its natural beauty, clean air, and good schools. Our economy is dependent on a light industrial base, tourism, fishing, and commercial services. In the last ten years our population has doubled, putting an unexpected strain on our landfill and other community services. Tonight we are here to conclude a series of meetings on our garbage crisis and vote on a proposal."

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Town Meeting: What To Do With Our Waste?

PROPOSALS UNDER CONSIDERATION

1. EXPAND THE EXISTING LANDFILL. Double the size of the existing Whale Bone Landfill. This expansion would bring the boundaries of the landfill within 300 yards of Jonah Elementary School and within 500 yards of the ocean.

2. SITE A NEW LANDFILL. Land values have tripled in the last ten years. The amount of open space available in the county is rapidly shrinking. There is a strong movement in the county to preserve existing open space.

3. RECYCLING AND COMPOSTING. An all-out effort to provide education, incentives and regulations to encourage widespread recycling and composting. Presently there is a pilot curbside recycling program in part of the town and the local community garden has composted for several years.

4. BUILD AN INCINERATOR. An incinerator could reduce the amount of garbage to be landfilled by 30-40%. Incinerators are expensive to build. New incinerators have pollution controls but some air pollution and toxic residue still results.

INTEREST GROUPS

1. GARBAGE HAULER

Your family has collected garbage in Whaler's Cove and the surrounding area for 50 years. You are concerned with providing good service to your customers at reasonable rates. You are quite certain that all of the proposals will cost you more to pick up the same amount of trash. Traditionally you have charged a set fee per household. If the amount of trash you pick up is reduced through recycling and composting, or if your tipping fees increase to pay for a new landfill or incinerator, you might consider charging people by the can. You started a pilot curbside recycling project last year. You would like to do more recycling, but this would mean hiring another crew and buying more trucks.

2. INCINERATOR PLANT VENDOR

You think incinerators are the way to go. Pollution controls have come a long way. Higher smoke stacks mean the smoke is distributed over a larger distance. Incineration reduces the amount of waste by 30-40%. You think the issue of toxic residues in the ash is a public education problem. People should be educated to put toxics in their proper place and not in the household trash. An added benefit of incineration is that burning trash can generate steam to turn turbines and produce some electricity.

3. CITIZENS RECYCLING AND COMPOSTING COALITION

You are a group of organic gardeners and environmentalists who have joined forces. You favor source reduction of trash, aggressive recycling, and efforts to educate the public. Your group proposes: a ban on extra packaging; curbside recycling collection; recycling containers on every street; home compost bins given out at discount prices; free compost and recycling workshops; composting and recycling in schools; more community garden sites with a community compost area, and an ordinance banning yard waste from being disposed of in the landfill.

4. LANDFILL OPERATOR

You are worried that your profits will suffer if people create less trash. You think siting another extra-large landfill in the area is the best solution. After all, people will always have trash and will need a place to put it. You do not think the public is willing to go through the extra hassle of recycling and composting; they just want to get rid of their trash. You think present-day landfills are safe and efficient. You can even capture the methane given off and produce small amounts of electricity. You remember the days of open dumps and dumping trash in the ocean. Landfills only use up space for a time, when full they are covered and can be turned into parks and open space. You have been in the landfill business for a long time. The only problem you see with landfills are citizens with a "N.I.M.B.Y." (not in my back yard) syndrome.

5. MUNICIPAL COMPOSTING PLANT VENDOR

You know that not everyone wants to compost at home. You propose to provide a valuable service to people and the community by charging them to pick up their organic materials, making compost and selling the finished compost back to the community. You would be providing the community with a high quality, locally produced compost at a competitive price and reducing the amount of material sent to the landfill by 20-30%. One large central facility would be better than having people compost at home: It could be permitted and regulated. Municipal composting has worked successfully across the U.S. and is used in some countries in Europe. Eventually the central facility might handle organic wastes from restaurants and agriculture.

6. HEALTH INSPECTOR

You are in charge of public safety and health. You would be responsible for permitting and regulating a landfill, incinerator or municipal composting facility. Air pollution and toxic residue from incinerators and ground water contamination from landfills, even the newer ones, have come to your attention in recent years. Municipal composting is still fairly new in this country. Regulations are still being drafted and you're not sure if composting on a large scale will work. You compost at home and the "gardener in you" thinks it would be nice if everyone composted, but the "health inspector" in you worries that home composting will not be done properly, and will lead to neighborhood complaints and rodent problems.

7. HOME OWNERS' ASSOCIATION

You are a member of the Sea Side Homeowners' Association and live next to Whale Bone Landfill. You enjoy your community's natural beauty, clean air, good schools, and rising property values. You are concerned with providing a healthy, unpolluted environment for your children to grow up in. Being a busy, working parent you are not sure how much time you have to deal with garbage. You feel you pay enough in garbage fees and do not want the rates to go up. You feel you pay bureaucrats and garbage collectors enough so that they should be able to find a solution to this problem.

SPREADING THE WORD
Students Teaching Composting

DESCRIPTION

After students have learned to compost, they can teach others about composting. Listed are four projects designed to help students spread the word about composting. These projects can be done individually or together as part of a large coordinated class project. These projects can be done in depth at the middle or high school level or simplified for younger students. (See younger student notations.)

THE PROJECTS ARE:

1. Giving a presentation or workshop on composting.
2. Developing a pamphlet or brochure on composting.
3. Promoting or marketing compost and compost related products.
4. Publicizing and promoting composting.

OBJECTIVE

Students will effectively plan and organize how to communicate their knowledge of composting to others. Students will work together in groups, use community resources, develop materials, and utilize written and oral communication skills.

GRADE

3 and up

TIME

On-going project

BACKGROUND INFORMATION

Composting is a new habit in our urban, late 20th century culture. Students learning about composting in school are probably more knowledgeable than their parents about issues of waste reduction. There is a genuine need to educate the public about composting and the process of nutrient cycling on this planet. Students can play a very valuable role in teaching others in their school and community how and why to compost. Children who understand the Earth's regenerative process of decomposition and our dependence on this cycle, understand something critical to our survival that many adults have forgotten. It is very empowering and appropriate for children to provide a needed community service, educating adults about composting and other critical Earth processes.

PROCEDURE

If you plan to do the four projects as a comprehensive, coordinated effort, split the class into four teams and give each team one of the four projects to work on. For a less involved project, a whole class can do just one project. For young students these projects can be simplified. (See the Younger Student notations.)

PROJECT: COMPOST PRESENTATION

DESCRIPTION

Compost demonstrations and workshops can be given at school fairs, community events, farmer's markets, school assemblies or to other classrooms. Students can target specific populations they want to address. Examples might be parents, teachers, administrators, gardeners, children's groups or neighborhood organizations.

PROCEDURE

1. Students in groups or individually, write down the information they think is necessary to teach someone to compost.

2. Create a master list of the information needed to be covered. Divide this information into categories to help organize the presentation. Why Compost, How to Compost, Troubleshooting and Questions and Answers is a typical format many compost presentations use.

3. Discuss what teaching format you will use. Will you have a workshop or a demonstration. Will it be participatory or lecture style? How much time will you have? What will the setting be like? Will it be outdoors or indoors? Who will be your audience? How many people will there be? What kind of background information do you think participants might bring with them? What types of materials and visual aides will you use, i.e., slides, drawings, demonstrations, etc?

4. Prepare an outline for the presentation.

5. As individuals or small groups, assign the tasks of researching, developing needed materials, and presenting portions of the presentation.

6. Practice and rehearse the presentation. Time yourself. Get feedback. Refine and make necessary changes.

7. After the presentation, do an evaluation. Write or discuss what was successful, what was not, how you felt, and what you would change if you did the presentation again.

FOR YOUNGER STUDENTS

For students with a worm compost, bring it to the lunch area or to a back to school night. Explaining what is happening to curious passersbys can be an informal presentation. Students could perform a song or skit, communicating why or how to compost, at a school talent show.

PROJECT: COMPOST PAMPHLET

DESCRIPTION

Written material explaining why and how to compost can be developed and distributed throughout the community and at compost workshops and demonstrations. Developing pamphlets and other written material is an exercise in combining writing and graphics in a concise way to convey information. If students have access to a computer, they can practice desktop publishing; if not, they can cut and paste using a copy machine.

PROCEDURE

1. Students individually or in small groups brainstorm and write down the information they feel is necessary to successfully compost.
2. Gather examples of other pamphlets and informational materials to get ideas on different formats and styles.
3. Decide what information will be included in the pamphlet.
4. Decide on the format and style of the pamphlet. How will it be organized? How long will it be? What drawings will be included? What type size?
5. Assign individuals or small groups the task of researching, writing, or illustrating portions of the pamphlet.
6. Compile all the information and illustrations, and edit it into a rough draft.
7. Get feedback, refine, proof read, and edit again until you have a final draft you are satisfied with.
8. Produce the pamphlets using a computer, typewriter or copy machine.

EXTENSION

Translate your pamphlet into other languages spoken in your community.

FOR YOUNGER STUDENTS

Students can draw pictures of the nutrient cycle with a compost slogan such as "Rot Is Hot" or "Don't Throw It Away". Students can write letters explaining why or how to compost and send them to a friend or relative. Students can produce a children's book explaining why and how to compost.

PROJECT: PROMOTION AND MARKETING

DESCRIPTION

Design, create and market any or all of the following: packaging to sell finished compost or worms in, compost T-shirts; bumper stickers, posters or pins. These items can be marketed at compost workshops and demonstrations or sold at fairs, farmer's markets, school fund-raisers, or door to door.

PROCEDURE

1. Study packaging and design. Bring in examples of packages, T-shirts, bumper stickers and/or posters. Discuss what information is conveyed by the product packaging. Is the message simply "buy this" or is there a deeper message. Which packaging and designs are effective in getting their intended messages across and why?

2. How much and what type of information do you want to convey with your packaging or product? How can you make it informational, attractive, and functional?

3. Research available materials for your package or product. What are the costs? Are there environmental considerations with using certain materials? How will you produce your product? How many items will you produce? Will you do the work by hand or just develop the design and pay someone to do the production? How much will it cost? Do you have to make a profit? If so, how much? What is your time worth?

4. Decide what you want your product to say. Come up with several ideas. Choose one or combine them into a new idea. Why did you choose the one you did?

5. Decide how you will sell your product. Will it be at a one-time event or will you have many opportunities to sell? Will you sell the product in conjunction with educational programs on composting, or will you sell it alone? Who is your market? Where do you find them?

6. Market your product. Evaluate what worked and what did not, how did you feel, and what you would change if you did this again.

EXTENSION

Students could buy compost containers and books on composting at wholesale prices and sell them for a profit. Composting kits, including everything one needs to start composting can be sold at compost workshops.

FOR YOUNGER STUDENTS

Used milk cartons from lunch can be decorated and used to package finished compost. Each student can paint a T-shirt with a compost theme. Wearing T-shirts with messages on them is a form of promotion. Book covers or greeting cards can be decorated with compost messages.

PROJECT: PUBLICITY

DESCRIPTION

The publicity project focuses on using the media to promote composting and advertise compost workshops, pamphlets or compost marketing projects.

PROCEDURE

1. Decide what to publicize. Is it a workshop, a product, or the idea of composting?
2. Decide what message you want to convey and what information people need to know. For example, if you are publicizing a workshop, you need to include the times, dates, and location.
3. Research what media outlets are available to you. Distributing flyers and posters, announcements in bulletins and newspapers, word of mouth, and public service announcements are some examples.
4. Decide what media outlets to use. Develop your material. This might mean designing and distributing posters or flyers or writing press releases for newspapers or public service announcements for radio stations.
5. Distribute your publicity. Evaluate which media outlets were the most effective. When people come to a workshop, ask them how they heard about your project or product. Make a chart to easily classify this information.

Title of Workshop **Date**

Newspaper	Radio	Flyer/Radio	Word of Mouth	Other

FOR YOUNGER STUDENTS

Publicity could be a compost poster contest where the posters are put around school. An announcement in the school bulletin, newspaper, or P.T.A. newsletter could tell what your class is doing with composting and where interested teachers, parents and students can go for more information. Cartoons encouraging composting can be submitted to newsletters and newspapers.