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Keeping our habitat healthy: A thematic unit for teaching environmental awareness for grades 3-5

Pamela A. Shetler

KEEPING OUR HABITAT HEALTHY: A THEMATIC UNIT FOR TEACHING ENVIRONMENTAL AWARENESS FOR GRADES 3-5

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education

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ABSTRACT

This curriculum unit offers teachers a thematic, multi-disciplinary, hands-on, literature-based method of developing students' appreciation and understanding of the world in which they live. The could be taught for approximately three weeks for students in grades three to five.

The curriculum begins with general activities to introduce students to the history of Earth Day and to our needs to sustain the Earth. Focus areas for environmental education include: solid waste management, air quality and toxics, and water quality. Curricular areas included are science; language arts, including reading, writing, grammar, and poetry; mathematics; social studies; physical education; art; music; and drama.

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INTRODUCTION

With the publication of Silent Spring by Rachel Carson in 1962, people became mindful of the need to be more aware of our effect on the Earth. The ecological movement, developed through the 1960's in the United States, was celebrated in 1970 on the first Earth Day. Unfortunately, the movement's growth slowed throughout the 1980's and 1990's. It is again gaining momentum as we approach the turn of the century because more people are realizing that our planet is still in peril.

It is imperative that young people learn respect for the Earth and develop environmentally friendly behavior. Education about the environment and the dangers to our world and ourselves should be a part of the curriculum in all elementary classrooms. There are many curriculum guides that address environmental education. Classroom teachers do not have the time to obtain and search all of these guides. This curriculum was developed by searching numerous manuals for appropriate lessons, developing a cohesive unit, and field testing the lessons on students in two classrooms. The project, as a whole, offers teachers a thematic, multi-disciplinary, hands-on, literature-based method of developing students' appreciation and understanding of the world in which they live.

Teachers already face a crowded school day. The many subjects and activities make teachers resistant to adding another area of study (It's Elementary, 1992). Thus, these lessons are thematically integrated so that environmental education does not become another subject added to the schedule. This follows the recommendation of the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (1990). Thematic teaching adds the value of studying an area in depth through repeated exposure. By concentrating on one environmental concept in all disciplines throughout the school day, students can more fully develop their understanding of the concept as well as learn the skills in each subject area.

This project reflects the recommendation in the The Science Framework for California Public Schools: Kindergarten Through Grade Twelve (1990) that students

at all grade levels experience science by doing activities that are hands-on at least forty per cent of the time. Through active participation students become active learners, as in the philosophy of constructivist teaching. A constructivist lesson is one whereby the teacher facilitates the students' learning through questioning while the students develop their own understanding of the material being studied through active participation (Klein & Merritt, 1994). Lessons emphasizing constructivist teaching are incorporated throughout the unit.

In addition to hands-on learning, students need exposure to quality children's literature as recommended in It's Elementary (1992). Through literature, children's interpretive thought processes are stimulated by discussions and questioning.

Though the unit as a whole is meant to be taught thematically, teachers have other options. If teachers do not want to implement the entire curriculum, it is also set up in a manner whereby the teacher may choose to include only one section or simply use selected activities in an existing program.

REVIEW OF THE LITERATURE

This review of the literature first defines and justifies the need for environmental education. Obstacles to the teaching of environmental education are identified and methods to address these obstacles reviewed. Next various teaching practices are examined, including whole language, thematic teaching, multidisciplinary, and hands-on methods. Finally, the most effective methods of dissemination for the project and teacher training are reviewed.

Defining Environmental Education

Educators have defined environmental education through a series of goals. The classic definition of environmental education is: "Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution" (Stapp et al., 1969 in Wilke, 1993, p. 35).

Klein and Merritt (1994) defined the goal of environmental education as to help children develop a sensitivity toward their environment, knowledge about the environment, and a commitment to taking action in defense of the environment . Students must learn to make informed decisions, exhibit responsible behavior, and develop action skills and attitudes to work toward solutions to current and future environmental problems and issues. Through environmental education, students discover what it means to be concerned about wildlife and the environment "upon which all life depends" (p. 15).

Two major conferences have taken place to more precisely define environmental education. In 1975, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) held a conference in Yugoslavia. The conference stated the following goals of environmental education: (a) foster awareness of and concern about economic, social, political, and ecological interdependence in urban and rural areas; (b) provide every person with opportunities to acquire the knowledge, values, attitude, commitment and skills needed to protect and improve

the environment; and (c) create new patterns of behavior of individuals, groups, and society as a whole toward the environment (Wilke, 1993, p. 35).

In 1977, a conference in Tbilisi, Georgia, Russia, set objectives that created a framework for curriculum development. These objectives included: awareness, sensitivity, attitudes, skills, and participation (Lisowski & Williams, 1993).

Overcoming Obstacles to Environmental Education

The first step in implementing an environmental curriculum is to convince teachers of the value of environmental literacy to their students. Teachers must be taught the philosophical and pedagogical nature of environmental education and how it can relate to their subject matter (Samuel, 1993). We, as teachers, are responsible for, "ensuring that the population at large understands ecological processes on which all life depends" (Evans, 1988, p. 137).

Next, teachers' knowledge about the environment must be increased. Teachers influence their students' environmental attitudes by those issues they choose to include and exclude from the school day. Therefore teacher training in environmental education is imperative (Samuel, 1993). There is a "relative paucity of pre-service teacher specialization opportunities in environmental education. It remains as an 'add-on' in science or social studies methods courses" (Wilke, 1993, p. 40).

In general, teachers have low environmental literacy (Buethe & Smallwood, 1987). Teachers' knowledge of environmental topics was measured by Buethe and Smallwood (1987) in the period from 1975-1985. These researchers measured environmental vocabulary, concept understanding, and attitude regarding the physical environment and related energy issues. Teachers showed that increases in knowledge of the tested environmental subjects were made during that ten-year period, but that there was still great need for teachers to acquire background information on various environmental concerns in order to help their students become better informed.

Many teachers view environmental education solely as part of the natural sciences. This is a predominant area in environmental education, and teachers' lack

of knowledge and confidence in the area of natural science acts as one of the barriers to teaching environmental education (Mirka, 1973). On the other hand, teachers need to be made aware of the non-science aspects of environmental education so they can effectively teach environmental education without strong science credentials. Through training, teachers can be taught the need for non-science environmental education (Simmons, 1989). This can only be done utilizing appropriate materials. "A greater variety of curriculum materials clearly needs to be developed or adapted for use in the non-science subject areas" (Simmons, 1989, p.17).

Teacher training is done most effectively through workshops (Van Koevering & Sell, 1983). An effective workshop should include active participation by the teachers (O'Brien, 1992). Workshops should introduce new learning for participants. Teachers must then be shown how to integrated the new knowledge into their curriculum (Van Koevering & Sell, 1983). Teachers only discuss topics in their classrooms that they feel knowledgeable about, so workshops should offer information to teachers on topics they are likely to use in their classrooms. This means it is best, when selecting workshop themes, to avoid two types of subjects: politically controversial issues that teachers may not present in their classrooms or highly technical issues that teachers will not feel knowledgeable about after only a simple workshop presentation (Van Koevering & Sell, 1983). Instead, training should include topics that teachers will feel positive about as research has shown that teachers are more likely to teach a topic about which they have a positive attitude (Van Koevering & Sell, 1983). Consequently, if an inservice improves teachers' attitudes about an environmental topic, they are more likely to teach that item and improve student exposure to the issue.

Once background knowledge has been offered, teachers need curricular supplements and guides with accessible materials (Mirka, 1973; Samuel, 1993). Primarily, teachers must be convinced of the value of the materials and understand how to use the handouts (Van Koevering & Sell, 1983). The ideal program is to offer teachers a curriculum that is ready-to-use. These guides should contain student and teacher materials. The curriculum should be presented through short workshops

that include hands-on participation by the teachers involved. Simple "make-it-and-take-it" workshops whereby teachers "learn it today and teach it tomorrow" are successful. Teachers who receive no training seldom effectively implement a program. Additionally, extended workshops at higher cost are less effective than short, less expensive workshops (Mayer & Fortner, 1987).

Teaching Methods

With the goal of environmental literacy for all children, environmental education must begin at an early age. Wilke (1993, p.63) presented a blueprint for teaching environmental education. For grade level ranges the major emphases and minor emphases are delineated. In kindergarten through third grade, emphasis should be on environmental sensitivity and ecological foundations. As children enter the upper elementary grades, issues and values should be emphasized, with minor emphasis on sensitivity. Throughout middle school and high school, emphasis moves to investigations, evaluations, and action skills.

Children need more than environmental slogans in order to be concerned with the environment (Weilbacher, 1994). Students need to be familiar with serious environmental problems and continuing efforts to alleviate these problems (Schwaab, 1982).

When teaching students about the environment, it is important to have them look at long term goals, but to act in the present. Some Native American tribes held this belief, as they based decisions on the effects on people of the seventh generation to follow. The Native Americans would plant trees, sparingly use wildlife and plants, and keep waterways pure, not only for themselves but for future generations (Mertz, 1993). Following the lifestyle of Native Americans, environmental educators work to move students to lead a life resulting in a sustainable future - to keep our habitat healthy.

The ultimate aim of education is shaping human behavior (Estes, 1993; Hungerford & Volk, 1990). Numerous studies have addressed how students can best be taught environmental literacy and the action skills to lead a life resulting with a sustainable future for the planet. The essential finding of these studies is that

knowledge does not equal behavior changes (Estes, 1993). In her 1990 study of attitude and behavior for environmental education, Newhouse (1990) concluded that, "Pure information does little to change attitude and consequently behavior" (p. 31). Teachers must be careful not to let facts and figures overwhelm their lessons, as can be the case when dealing with environmental issues (Sumrall & Aronin, 1993). Skills do not evolve naturally from knowledge. Students must gain knowledge as a prerequisite to appropriate action, but knowledge is only a catalyst (Newhouse, 1990). Current environmental educators view their purpose as more than offering information and teaching practical skills (Wilke, 1993). "Learning does not necessarily translate into more responsible behavior toward the environment" (Finger, 1993, p. 17).

Students must develop their own attitudes and awareness of actions on a global and international scale (Euston, 1993). This can be done through in depth investigation and real-life dialogue in the classroom (Euston, 1993). Ownership of environmental responsibility and empowerment of the student was recommended by the 1990 United Nations Conference on Education (Estes, 1993). These types of educational experiences can "bring meaning to the future, a feeling of relationship to the land, human well-being and a love of nature" (Euston, 1993, p. 23). These sensitivities then enable people to make their own moral judgments about environmental matters. Educators must see that all students have the tools to make these decisions responsibly (Newhouse, 1990).

Having established the need for environmental education and overcoming obstacles to teaching it, the question becomes how to best accomplish this task. Pam Stryker, 1992 Winner of the National Presidential Award for Elementary Educators, stated, "Trying to relate environmental education to all areas of the curriculum is how educators will make a difference" (Estes, 1993, p. K8). Researchers have shown that effective environmental education is best presented as an interdisciplinary approach (Lisowski & Williams, 1993). This can be done through a modification of the current curriculum to include environmental issues. A model of this type, called the infusion model, teaches environmental education as an

integral part of the major content areas (Lisowski & Williams, 1993). "Infusion is a pragmatic approach to finding room for environmental education in a crowded curriculum (Wilke, 1993, p. 39)." Environmental education should be infused throughout the curriculum at all grade levels (Simmons, 1989). Magnet schools, such as Kimbark Elementary in the San Bernardino City Unified School District, also have school-wide infusion programs (Stoner & Overbey, 1989).

Though infusion, at some level, is the most common way that environmental education is taught in the United States, it is generally not infused totally across the curriculum. Cases where it is, such as those cited, are rare. Some educators have become wary of general infusion of environmental education because depth is often missing in infused curriculum (Wilke, 1993).

Holistically approaching environmental education, rather than teaching it as a separate subject, is especially effective in the elementary classroom (Iozzi, 1989). Too often, divisions exist in schooling. Relating environmental education conceptually to a given subject matter and then teaching it with thematic units makes sense pedagogically (Samuel, 1993). This aids in teaching in a constructivist manner. Students relate the information they are learning throughout the day to existing knowledge and see the importance of the new information (Newhouse,1990). This follows the recommendation of the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (1990) and It's Elementary (1990).

"Thematic approach is an efficient use of time, materials and energy" (Brountas, 1989, p. 53). It is important to bring science and the humanities together (Goldbort, 1991), and this is readily done with a multidisciplinary approach to environmental education. The benefits of integrating science into the existing curriculum were shown by O'Brien (1992). When disciplines are integrated, materials can be shared, such as reading or writing about fiction books that have a scientific theme (Goldbort, 1991). Language art skills are more meaningful activities when used with purposeful reading (Bristor, 1994). Writing assignments and poetry lessons can have environmental subjects. Letter writing, in particular, can allow

students freedom of expression and demonstrate the impact they have on many people (Sumrall & Aronin, 1993). The environment of the setting used in a story can be examined, analyzed, and discussed. Comparisons and contrasts to the students' own environment can be made. Critical thinking skills are increased and attitudes are shaped through discussions of environmental issues (Wilke, 1993). As Simmons (1989) noted, "It only takes a little extra time to use environmental issues and concerns to teach skills and concepts in subject areas" (p.15).

When works of literature are used in thematic teaching, ideas are seen as a whole, and relevance is apparent (Goldbort, 1991). California and other states have mandated the use of whole works of literature (Bristor, 1994). Teaching in a whole language format using children's literature in an integrated curriculum is rooted in Piaget's constructivist theory of learning (Heymsfeld, 1992).

Researchers have studied the effects of integrating science and reading specifically. Bristor reported on a five year study in which teachers in grades four and five combined their reading and science time slots and were taught reading through the content area of science. This included using the science reading to work on specific skills such as identifying cause and effect and main ideas. The teachers of the experimental group used trade books and supplemental technology to increase students' background. Control classes used the basal reader and science book in the traditional separate manner. Students were of varying ability levels. When tested using standardized tests the experimental group showed statistically significant increases in both their reading and science scores over those students taught in the traditional manner. In addition to the increases in academic areas, students showed increases in attitude and self-confidence (Bristor, 1994). Romance, one of the original researchers in this study, felt this could be attributed to, "an integrated curriculum strategy, emphasizing science process skills and hands-on activities, that expanded the time allocated for in depth science instruction" (Romance & Vitale, 1992, p. 545). Lack of adequate science instruction time is a major problem for teaching quality science.

When taught in an interdisciplinary manner, students can be challenged to assimilate the information they have acquired in various disciplines, without staying within the specific monodiscipline approach. Relating ideas from various disciplines fosters higher level thinking skills that aid students to reach higher levels on Bloom's taxonomy. The first recommendation of the California Elementary Grades Task Force, as outlined in It's Elementary (1992, p. 22) is to, "Make a rich, meaning-centered curriculum the centerpiece of instruction for all students in all subject areas in the elementary grades." Other recommendations of this task force are also addressed by thematic teaching. These include scheduling class work in longer blocks of time and choosing depth over coverage in teaching a subject.

The Science Framework for California Public Schools: Kindergarten Through Grade Twelve (1990) also recommended that lessons be taught around a theme. It pointed out that there is value in studying an area in depth. By concentrating on a concept in all aspects of the school day, that concept will become more deeply rooted for the student. Learning through a multi-disciplinary mode also allows time for all subject areas to be covered.

In addition to thematic teaching, the The Science Framework for California Public Schools: Kindergarten Through Grade Twelve (1990) work recommended that students at all grade levels experience science by doing activities that are hands-on at least forty per cent of the time. Hands-on activities involve tactile and kinesthetic modalities and have been shown to lead to active and better learning (Heymsfeld, 1992). It is the opinion of Bristor that hands-on activities give students, "an operational definition for understanding concepts rather than a meaningless, dictionary response" (Bristor, 1994, p. 34).

Thematic teaching touches both the cognitive and the affective domain. Research has shown the need to teach to all learning modalities. When music, art and drama concerning the environment are included, those students with different learning styles can be reached (Iozzi, 1989; Weilbacher, 1991).

Thematic teaching can be coupled with co-operative grouping as a highly effective teaching practice. Children working in small groups have been shown to

be more actively engaged in their own learning (Heymsfeld, 1992). Students are generally more engaged because group work increases motivation. As students work together they teach each other which has been shown to increase self-confidence and independence (Heymsfeld, 1992). Solutions to many issues require multi-disciplinary input (Evans, 1988). Since saving our habitat will require cooperation between individuals and groups, it is only appropriate that environmental education employ group-work situations.

Through active participation, students become active learners. Students participating in authentic tasks learn effective problem solving, and develop and defend their personal positions (Klein & Merritt, 1994). Direct contact leads to attitude and behavior consistency, two of the objectives outlined at the Tbilisi Conference (Newhouse, 1990). Inquiry and projects dealing with real-life problems lead to effective learning (Schwab, 1982). As previously mentioned, this too can assist those students of various learning styles. Using more senses in a lesson involves students who learn by various modes (Iozzi, 1989).

Models of instruction that place the student in meaningful learning activities, rather than passively responding, are most effective (Harris & Pressley, 1994). "Learning is an active process of conceptual construction and reconstruction that is facilitated by hands-on/minds-on activities and social interactions, not passive absorption of prepackaged knowledge" (O'Brien, 1992, p. 422). This is a type of constructivist lesson. The teacher facilitates the students' learning through questioning, while the students develop their own understanding of the material being studied through active participation. Students take the material they are encountering and construct its meaning by synthesizing it into their prevailing structures of knowledge. The responsibility for learning lies with the learner in partnership with the teacher (Klein & Merritt, 1994).

Constructivism strives to communicate the "big ideas" or primary concepts to learners. This is one of the recommendations of It's Elementary (1990). In a constructivist lesson, students explore the idea, invent methods for investigating, and finally discover the concept for themselves (Brooks, 1990). Students work to

link bits of information and strive for equilibrium. It is critical that teachers include pre-activities to determine what the students already know so that students can connect new learning to their already present schema. Teachers can facilitate this by the process of scaffolding (Heymsfeld, 1992). This can be accomplished by the KWL technique: determining what the children Know, what they Want to know and what they have Learned when the lesson is completed. If a student's hands-on work shows an error in her initial idea, she can use her experience to correct that error (Newhouse, 1990). Furthermore, the teacher acts as a guide, looking for misconceptions to be addressed in future lessons. This type of lesson, combined with knowledge-based and skill-based lessons, gives students a balance to achieve the educational goals of both content and skills (Brooks, 1990). Teachers who have learned to balance exogenous constructivism (modeling and explanations) with endogenous constructivism (exclusively discovery-based learning) will have the greatest success in their instruction (Harris & Pressley, 1994).

Through environmental education, students build an emotional attachment to the environment, as well as knowledge about the environment. Direct contact and control in their learning leads students to attitudinal and behavioral changes, as desired by the UNESCO goals. Attitude and behavior changes result from students perceiving an internal locus of control (Newhouse, 1990). Interactive education, such as constructivist lessons, leads to dialogue which develops this internal locus of control in an individual. Students who develop an internal locus of control, feel personal responsibility, and have a positive attitude toward the environment (Hines, Hungerford, & Tomera, 1986) and are more likely to participate in environmentally responsible behavior (Newhouse, 1990).

While environmental education strives to teach environmental literacy to all students, it is interesting to note that a study by Stoner (1990) has shown environmental education can serve as drop-out prevention due to its motivating and relevant content, interdisciplinary applications, addressing of various learning styles and the sense of connectedness it gives the student.

Students must understand that it is a myth that knowledge and technology can manage the Earth. Though technology can help solve some of the Earth's problems, positive attitudes and behaviors of the people of the world are necessary to address and resolve most issues since everyone is part of the world community. Such existing societal attitudes have hampered scientists' ability to solve many of the world's environmental problems (Iozzi, 1989). As the world's population increases, the role of the environmental educator becomes even more important than it has been in the past as the values and conscience children develop are more critical (Newhouse, 1990).

Desired responsible environmental behavior is difficult to achieve. Students often adopt positive environmental behaviors if a teacher they respect models these behaviors. Van Koevering and Sell (1983) reported that there is some evidence teachers pass their attitudes along to their students. As a consequence, students see the benefits outweighing the costs (Newhouse, 1990). Teachers must be certain they are not manipulating the learner, but rather giving the learner true skills to be used in future decision-making. Many environmental issues can be presented as moral dilemmas. Students must see that two-sided communication is necessary (Newhouse, 1990) and that truly caring for the environment means considering all sides on issues (Carlson, 1993). Through role-playing and debates, multifaceted issues can be addressed.

Students have intense interest in these multi-faceted environmental issues as they hear and read about global controversies on a daily basis. This interest can motivate students as they link science to real world problems (Carlson, 1993). As students learn and use investigative skills they can then analyze issues from their own perspectives (Kauchak, Krall, & Heimsath, 1978). Students can learn to use value-analysis activities to understand their own environmental values (Iozzi, 1989). As students reach higher levels of moral reasoning, teachers can help students to explore environmental scenarios through discussions at higher moral reasoning levels, as defined by Lawrence Kohlberg (Iozzi, 1989).

The The Science Framework for California Public Schools: Kindergarten Through Grade Twelve (1990) stresses the importance of values and ethics as components of science teaching. "Students become scientifically literate citizens responsible for themselves and the world's future only if they are well prepared to assume that responsibility" (1990, p. 3). One of the steps to achieve this component is to, "Develop rational decision-making skills applicable to major issues of personal and public concern (1990, p. 158)." Environmental issues investigations are clearly major causes of personal and public concern and of importance to students. So as students gain action skills necessary to effect change, they must acquire a desire to act as well (Hines, et al. 1986).

A Senegalese conservationist, Baba Dioum, said, "In the end, we will conserve what we love, we will love what we understand, and we will understand what we are taught" (Estes, 1993, p. K6). It is important for educators to teach about keeping our habitat healthy to all people and, "dream big before we lose it all" (Elder, 1994, p. 56).

GOALS AND OBJECTIVES

The goal of this project was to create a literature-based, thematic unit of approximately three weeks for students in grades three to five. The purpose of the unit was to help children gain environmental awareness, responsible and positive attitudes, specific knowledge, and the commitment to take action for the environment.

This goal was achieved in the following manner:

1. Develop a three-week thematic unit covering three main areas of environmental issues that included solid waste management, air quality and toxics, and water quality. The unit included selected children's literature and activities covering curricular areas including: are science; language arts, including reading, writing, grammar, and poetry; mathematics; social studies; physical education; art; music; and drama.
2. Reviewed by the writer's colleagues.
3. Field test these activities in the writer's, as well as colleagues', classrooms. Modifications were made to some of the lesson plans.
4. Provide workshops and inservices about the unit to other teachers and thus distribute it.

DESIGN OF PROJECT

The thematic unit includes general activities to introduce students to the history of Earth Day and to determine what our needs are to sustain the Earth. Focus areas include: solid waste management, air quality and toxics, and water quality. Curricular areas include science; language arts, including reading, writing, grammar, and poetry; mathematics; social studies; physical education; art; music; and drama.

Numerous curricular guides containing lessons relating to environmental education were acquired and perused. Lessons appropriate to the subject matter and the grade level were selected. Some lessons were adapted from the original source. It was desirable to use some lessons in their original form. In these cases, permission to use the lessons was requested by mail from the publishers. Where permission has been granted it is noted on the lessons. Other lessons are original and were developed by the writer.

Various children's literature was also scrutinized by the writer for its appropriateness and value in the curriculum. Titles readily available, in most cases, were chosen. Lessons were selected and developed for use with these titles.

The unit consists of lesson plans to be taught over a three week period. Weekly plans include an overview and objectives for the week. This includes daily instructional and activity suggestions in all curricular areas, with brief descriptions of all lessons. After each set of weekly plans are the background information sheets and detailed instructions for each activity.

Additionally, appendices include an annotated bibliography for the literature selections, a list of curricular guides from which lessons were taken, and a video and audio resource list.

A pre- and post-assessment covering attitudes is included. The activities were field tested in my classroom and those of my colleague to be certain they are effective and useful for intermediate grade students.

IMPLICATIONS FOR EDUCATION

Educators are often hesitant to teach environmental education for various reasons. Ham and Sewing (1987) found the reasons to be: another subject to add to an already full day, and lack of knowledge in science, lack of materials, lack of funding, and lack of preparation time. The project has addressed these concerns. The curriculum developed is thematically integrated so that all subject areas are covered with environmental learning as an integral part. Lessons include all necessary background information. Most of the materials needed are readily available in a typical classroom setting or easily obtainable at low cost. Finally, the lessons are planned in a manner that the teacher can simply teach the unit from beginning to end, with no further planning, if desired.

The curriculum can readily be taught in its entirety to cover a broad look at environmental education. Alternately, any of the concepts within the curriculum can be taught separately from the rest. Therefore, the unit can serve as a source of activities and lessons from which a teacher might choose to add to an existing program.

RESULTS

The writer field tested the unit in her fourth grade classroom and her partner's fourth grade classroom. The field test data was used to modify the final lessons.

Students enjoyed the hands-on activities, games, and books. Though the students had a high level of environmental awareness before the unit was taught, there were changes in attitude and willingness to take action for all students. Students wrote to manufacturers about excess packaging after completing the lesson "Necessary Wrappers" and evaluated the responses they received from the companies. When performing the plays, the students showed emotion in their characterizations. Subsequently to reading some of the books and watching the suggested videos, the students expressed sophisticated ideas about waste and its management. Attempts at cleaning up the oil spill in "An Oil Spill in the Classroom" and "Critter Clean-up" evoked empathy in the students. The students observed by the writer made tremendous strides in both their knowledge and attitude toward environmental pollution problems.

Currently the writer is in the process of sharing the unit with other students through interested teachers. Subsequently to the completion of the unit, 16 teachers throughout the area have been inserviced on implementation of the project. In the workshop evaluation, these teachers expressed the usefulness of the activities. One teacher wrote, "The unit included a wide variety of accessible ideas that I will be able to effectively use." Another commented, "The curriculum guide is a good resource to have. All of it!" These teachers are currently field testing it. Other workshops are presently scheduled for further distribution.

APPENDIX A
Weekly Plans

Week 1

Overview and objectives

Students will:

Examine their own needs and wants.
Be introduced to the idea of Earth Day and its history.
Begin a group chart on pollution.
Set up a mini-compost bin to chart decomposition.
Increase their sensitivity to the needs of the Earth.

Day 1:

Setting the Stage:
Give *Pre-assessment* (1.1). Compare to the desired answers on the *Pre-assessment Key* (1.2). Save to compare to post-assessment. Write "Earth Day" in the center of a large piece of paper. Ask the students to tell you all that they know about Earth Day.

Earth Day Background: *Earth Day Teacher Background Sheet* (1.3) - 20 minutes
Read aloud *Earth Day* by Linda Lowery. This book gives a history of Earth Day and its celebration. When complete, tell the students that over the next few weeks they will be learning many ways to help our planet, just like the people did on that first Earth Day. Have the students calculate how many years have passed since the first Earth Day in 1970.

Bulletin Board:
Make a large chart with three headings, "Problems," "Causes," and "Solutions." Tell the students that as you proceed through the unit, they will add to this chart. As topics are covered, ask the students for input on the chart. If possible, have the students write responses on the chart. Pictures can be added from magazines or by drawings or water color if desired.

Social Studies, Science:
Needs and Wants (1.4) - 45 minutes- Activity to distinguish between personal needs and wants.

Music:
Teach the students the song *"It's a Small World"* (1.5) by Sherman and Sherman, Walt Disney, Inc. Teach the three additional verses. Sing throughout the week.

Drama:
There are two plays with 34 assigned parts so students can be a performer in one of the plays. If the plays are rehearsed simultaneously, all students can be involved at once. *Throwaway Three* (1.6) is a short (15 minute) skit by Fay Bradley looking at what various civilizations have thrown away throughout history. *The Awful Eight* (1.7) is a skit (20 minutes) that has two reporters interviewing various toxins. You could invite other classes for a mini-assembly where you might perform one of the plays.

For this assembly you might contact your county health department and ask for a speaker on hazardous materials to come out to your classroom. Ask the person to bring protective clothing that the children might try on including a gas mask. The assembly could include one of the dramas your class will work on during the unit.Begin to plan the play this week and continue through next week.)

Follow the performance by sharing *Junk in Space* by Richard Maurer with the students. This book shows what technology is leading us to throw away in space.

Day 2:

Language arts: 45 minutes
Read *Joe's Earth Day Birthday* by Karen Scovel. Make a chart with the headings "David's Party" and "Joe's Party." Have the students list what went on at each. Lead discussion questions:
1. Were both of the parties fun?
2. What things bothered Joe about David's party?
3. Have you been to a party like David's? Like Joe's?

Have the students do a "Quick write" on the topic "How can I make my next party more Earth-friendly?" (A quick write is a short writing assignment. The students will write quickly to get as many ideas on paper as possible. No erasing is allowed. Grammar will not be graded or corrected. This is a form of brainstorming on paper.) When students have had 5-10 minutes, ask them to silently read what they have written and choose one item to share with a neighbor when you give them the signal. (Paired sharing makes all students feel they are sharing their ideas without taking a large amount of time and boring the class with repetitions.) Collect the quick writes to be used in assessment.

Math:
Graphing Wrapping Paper (1.9) - 45 minutes - Students will estimate the amount of paper thrown away by the class and use these estimates in various mathematical ways.

Social Studies, language arts, and art:
Spaceship Earth (1.10) - Students will pretend they are captains of an intergalactic spaceship. They will determine what is needed to keep their crew alive. Discuss questions one and two in class. Assign the remainder for homework to be discussed tomorrow. Display students drawings.

Art:
Polluting a Special Place (1.11) - To increase students' sensitivity to littering each will create a drawing of their special place. The teacher will then add pollution and the students will write about their feelings.

Science:
Create *Mini-decomposition Container* (1.12) - that will be observed on a weekly basis throughout the unit.

Day 3:

Language arts: (90 minutes)
Just a Dream by Chris Van Allsburg - Read aloud
Environmental Concepts: People's actions have environmental consequences.
People have made changes in the environment that have led to the endangerment and extinction of plants and animals.
It is important to keep our environment safe and healthy.
People cause environmental change.
People make personal choices which effect the conserving, recycling, or destroying of natural resources.
People have a responsibility to conserve and protect the natural resources.

Describe Walter at the beginning of the book. Have you ever felt like Walter? Can recycling seem like a bother?
Describe Walter at the end of the book. (For older children, compare and contrast Walter from the beginning of the book to the end.)
What type of company did the loggers work for? Why did this have an effect on Walter?
To what type of company did the smokestacks belong? Why did this have an effect on Walter?
The men on the boat were overjoyed. How would you feel if you were fishing and Would you be if you were a fisherman and had caught only your second fish for the week? Why or why not?
In the last scene, Walter thinks he has now gone to the past because he sees a push lawn mower and clean clothing on a clothes line. Is he in the past? Explain.
Have you ever felt like Walter did in the beginning of the story?
What changes do you think Walter will make in his actions?
What are some changes you can make to help the environment?
If one person changes their actions toward the environment, can s/he make a difference?

Assessment: Have students complete the *Open Mind of Walter* (1.13). Students should be encouraged to draw pictures and write words in Walter's head showing his thoughts before the dream and after.

Social Studies/Science: 45 minutes
Necessary Wrappers (1.14) is a simple activity to show the amount of packaging of some products versus the amount of product. Students compare the packaging used in one package of gum to the product, the gum itself, to see the extensive packaging used. **Science background -** Some packaging is necessary to protect products from bacterial and contamination, others from breakage, and some for shipping purposes. Have students determine which packaging they feel is needed and why. Discuss what we can do with packaging such as recycling the aluminum, paper and plastic.

Homework - Ask students to look for examples of excess packaging and environmentally friendly packaging. If possible, have them bring the package, with or without the product, to school tomorrow for a writing assignment.

Math and social studies: Over a one week period, with a 20 minute lesson
An possible follow-up activity is having the students save all of their families' packaging for one week and then bring it in to school. Even with only partial participation, a tremendous amount of packaging is collected and makes a visible impression on the students. From the amount brought in, you can lead a math estimation lesson extrapolating the amount of trash that would be discarded by the class, the school, the neighborhood in a week. Also the amount of trash for each of these groups for a month or a year can also be described.

Day 4:

Language Arts: 45 minutes
Students write a personal, persuasive essay on one change they will make in their life to help the environment. Brainstorm as a class ways that students can make personal changes that can help the environment. **Science background -** See *50 Things Kids Can Do to Save the Earth* for ideas in this prewriting discussion. Students will then choose one of the ideas. Even students from environmentally conscious families should be able to come up with one new thing they can personally do. If that is not possible, their essay may be about something they are already doing and the purpose can be to convince others to do the same. The essay should include specific changes and what the expected results of the changes will be. All essays should also be written persuasively to convince others to also make similar changes.

Art/math: Homework
Students can use discarded items such as cardboard boxes and tubes to create geometric space figures. (Space figures may either be alien-type forms or simply figures that take up three dimensional space.) These space figures should contain various geometric shapes such as cylinder, rectangular prism, pyramid, and sphere all made out of materials that would otherwise be discarded. Each geometric shape should be labeled. Students will orally present their space figures at which time they will explain what type of trash each part of the figure came from.

Social Studies: 45 minutes
Students write letters to manufacturers who students believe use excessive packaging. Those who have examples of minimal packaging should write to the manufacturers to commend them on their Earth-friendly packaging. The teacher might wish to bring in examples for the students to write about if they haven't brought any packaging themselves. This helps the students begin to feel their ideas and opinions are important and can make a difference.

Day 5:

Science:
Ranking Litter (1.5) - 45 minutes- Students work in groups to decide on the harm to animals, plants and the environment of various types of litter.

Language arts:
Capitalization worksheet (1.16) - Basic skills

Language arts:
Environmental Beat It (1.17) - 30 minutes to introduce the first day, 5 minutes each subsequent day - Vocabulary drill that will be done on a daily basis throughout the unit. The name comes from the fact that the drill is timed and each day the students try to beat the previous time.

Social Studies:
Read *Brother Eagle, Sister Sky* by Susan Jeffers. Discuss the way Native American tribes revered the earth. Compare the Native Americans with Walter from *Just a Dream* by Chris Van Allsburg before and after his dream.

Math/Social studies:
One Potato, Two Potato (1.18) - 45 minutes- Students will look at packaging size and cost comparisons.

Earth Day Unit Pre-assessment

1.1

Read the sentence. Check always, sometimes or never.

	Always	Sometimes	Never
1. I carry my lunch in a reusable bag or box.			
2. I take long showers.			
3. I put leftover paint and oil in the trash.			
4. I give things away instead of putting them in the trash.			
5. I use recycled paper.			
6. I throw all aluminum cans in the trash.			
7. I turn up the heater if I'm cold.			
8. I let the water run when I brush my teeth.			
9. I use paper towels to dry my hands.			
10. I walk when I can instead of riding in a car.			
11. I use both sides of paper.			
12. I pick up trash when I see it on the ground.			
13. I use a hose, not a bucket, to wash the car.			
14. I let the water run to be cold for a drink.			
15. I turn off lights when I leave a room.			
16. I buy things with little packaging.			
17. I use ant spray to get rid of ants and bugs.			

Earth Day Unit Pre-assessment Key 1.2

Read the sentence. Check always, sometimes or never.

	Always	Sometimes	Never
1. I carry my lunch in a reusable bag or box.	X		
2. I take long showers.			X
3. I put leftover paint and oil in the trash.			X
4. I give things away instead of putting them in the trash.	X		
5. I use recycled paper.	X		
6. I throw all aluminum cans in the trash.			X
7. I turn up the heater if I'm cold.			X
8. I let the water run when I brush my teeth.			X
9. I use paper towels to dry my hands.			X
10. I walk when I can instead of riding in a car.	X		
11. I use both sides of paper.	X		
12. I pick up trash when I see it on the ground.	X		
13. I use a running hose to wash the car.			X
14. I let the water run to be cold for a drink.			X
15. I turn off lights when I leave a room.	X		
16. I buy things with little packaging.	X		
17. I use ant spray to get rid of ants and bugs.			X

The History of Earth Day

Throughout history, people have created wastes that were put into the environment. As the 1960s dawned, people began to realize the need for some control of the pollution being created. The air, water, and soil were being polluted at greater rates as the population increased.

In 1969 an oil well off the coast of Santa Barbara, California sprang a leak, creating a massive oil spill. The public became outraged. Unfortunately, the country's leaders were not listening to the public.

Senator Gaylord Nelson from Wisconsin traveled throughout the country extensively. He became concerned about the environment and the lack of legislation from Congress. Senator Nelson came up with the idea that Americans could set aside one day to learn how to care for the troubled planet. The day could be called Earth Day.

Senator Nelson contacted people throughout the country to help him in the planning. One of these people was a law student named Dennis Hayes. Mr. Hayes spent a full year preparing for Earth Day.

On April 22, 1970, the first Earth Day was celebrated. More than 20 million Americans took part. People went to classes to learn how to save our planet. There were concerts, nature walks, and celebrations. Businesses closed for the day. The mayor of New York City closed Fifth Avenue for the day.

The first Earth Day was a big success. Congress passed laws to protect the environment. A new government department was formed to help with the laws, the Environmental Protection Agency, or EPA.

Earth Day was celebrated in 1990 and continues to be a yearly celebration.

NEEDS AND WANTS

Goal:
Students will distinguish between personal wants and needs.

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

Grades:
3rd - 6th

Materials:
- Scissors
- One set of duplicated activity pages per pair of students
- One envelope for each pair of students
- Paper for each student
- Pencil for each student

BACKGROUND

People have different ideas about what defines "needs" and "wants" depending on their culture, background, values, and situation. For example, in our culture electricity might be viewed as a need but millions of people around the world live happy and productive lives without electricity. Similarly, a computer might be considered a need by many business people while other people would consider a computer a want, not a need.

In this activity, students will examine things in their lives to determine the difference between "needs" and "wants".

The students will have different feelings about what is a need or a want; allow them to express their own ideas. Some of the items illustrated in the student activity pages were purposely chosen because they could be viewed as either needs or wants, depending on the student. To help students express their ideas, they create simple poems called cinquains that have five lines. Cinquains are a wonderful way to combine feelings and facts about our world into a poetic image. They are easy to create as well as fun.

Although every person has different ideas about what is necessary to him or her, there are certain basic needs that all humans share, including biological needs (food, water, air, and shelter), social needs (clothing, feelings of belonging, and protection), and spiritual needs (faith, hope and love). Students will explore some of these needs in this activity.

PROCEDURE

1. Make copies of the "Needs and Wants" activity pages so that each pair of students will have a set. Cut the cards along the dotted lines and place each set of cards into an envelope (students can help do this).

2. Divide students into pairs. Pass out one envelope of cut-up cards to each pair. Direct student pairs to sort the cards in their envelopes into piles so that the things in each pile are alike in some way. Ask students to share with the class the "rule" they sorted by. On the board, begin a class list of ways to sort the objects. Allow students several opportunities to re-sort the objects, encouraging them to look for new ways to sort.

SAMPLE CINQUAINS:

WATER
Wonderfully wet
Trickling, roaring, moving
It feels so cool
Wetness

WIND
Waving, blowing
Moving rain clouds
Nice on my face
Breath

3. Have students put the cards back into the envelopes, then discuss with students the difference between needs and wants. Ask: Could you live without the things you need? The things you want? Ask students to sort the cards according to needs and wants, then discuss which things they think are needs, which are wants, and whether different people have different ideas about what they need.

4. Tell students that there are certain things, called basic needs, that everyone absolutely has to have in order to stay alive and healthy. Ask which of the things on the cards are basic needs and list student responses on the board. Ask students if they can think of any other things not on the cards that might be considered basic needs. Add appropriate responses (trees, animals, and love, for example) to the list.

5. Explain to students that they will create poems of five lines called cinquains about one or more of the basic needs listed. Write on the chalkboard the sample cinquain or a cinquain you create. Explain to students the rules for cinquains:

First line: 1 word, giving title

Second line: 2 words describing title

Third line: 3 words expressing an action

Fourth line: 4 words expressing a feeling

Fifth line: 1 word, a synonym for the title

Have students work alone or in pairs creating these brief, evocative poems, then ask students to share their creations with the class or in smaller sharing circles.

DISCUSSION/TEST QUESTIONS

- Why are basic needs important to us?
- Are there things people do to protect these basic needs?
- What is the difference between a need and a want?
- Is there anything that you consider a need that someone 100 years ago (or in another country today) might consider a want?

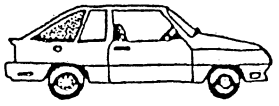
Adapted from the ***California State Environmental Education Guide, 1988***

NEEDS AND WANTS

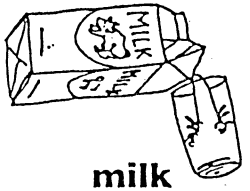
(cut cards apart)

quiet

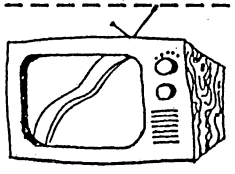
friends



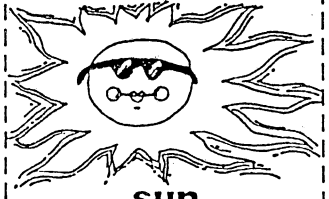
car



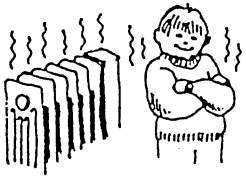
milk



television



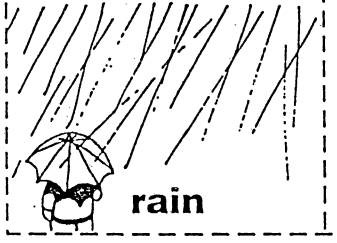
sun



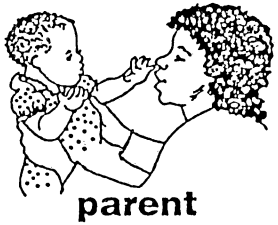
warmth

home

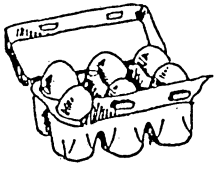
dollars



rain



parent



eggs

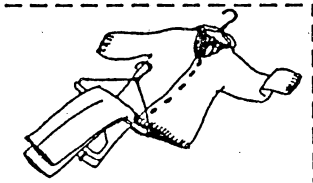
air

NEEDS AND WANTS

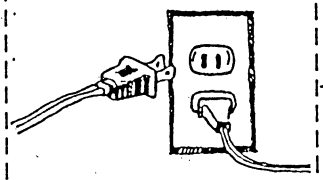
(cut cards apart)

vegetables

fruit



clothes

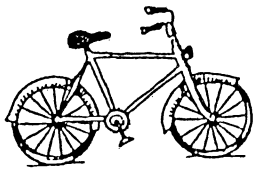


electricity

medicine

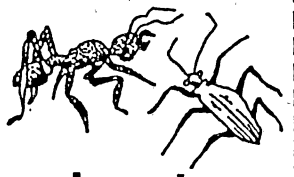
yard

water

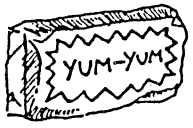


bicycle

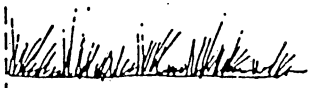
computer



insects



candy



grass

nuts

It's a Small World

1.5

It' a world of laughter, a world of tears,
It's a world of hopes and a world of fears.
There's so much that we share that it's time we're aware.
It's a small world after all.

Chorus:
It's a small world after all.
It's a small world after all.
It's a small world after all.
It's a small, small world.

There is just one moon and one golden sun
And a smile means friendship to everyone,
Though the mountains divide and the oceans are wide, It's a small world after all. (Chorus)

There is just so much water and so much air
And just so much land and food everywhere
There's so much we must share, oh it's time we're aware
It's a small world after all. (Chorus)

So many people using up so much so fast
We cannot go on as we've done in the past.
It is time to confess, we have got to use less
It's a small world after all. (Chorus)

On this spaceship earth we are all in a crew
And we've got to learn what we must do.
It is time we're aware, we use more than our share
It's a small world after all. (Chorus)

Created by Mary Hallesy and the 1976 LeConte Lodge Summer Staff.
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THROWAWAY THREE

A short skit

By Fay Bradley

Reprinted from "Lessons from Litter" by permission of the Atlanta Clean City Commission.

"Throwaway Three" is a skit in rhyme written for three actors. To involve a larger number of students, a different person may be used for each of the ten roles.

Each part has three notations beneath it. The first is the character's date in history. Make signs for each of these dates and have one person hold up the appropriate sign at the appropriate time in the skit. The second notation is the name of the character (Monkey, Cave Dweller, etc.). The third notation describes the props. These include both the costume for the person in history and the articles thrown away.

The central idea is that as the skit progresses, each person throws more trash on the pile in the middle of the room so that a high stack is created. The skit suggests that one way to solve the problem is to recycle. A discussion of ways to solve the problem of too much garbage and trash might follow the performance.

PROP LIST:

monkey masks
banana peel
orange peel
skins
Roman helmet
bag of trash
sack of trash
Pilgrim hat
quilt
coonskin hat
leather harness or belts
engineer's cap
three sweaters: one handmade, two machine made
lab coat
nylon stockings
plastic bags and containers
perma-pressed shirt
TV dinner
small broken appliance
toy car
Indian headband
cola bottle
clear bottle
flower

THE THROWAWAY THREE 1.6

Person 1

This is the tale of the Throwaway Three
Of humans and garbage throughout his-to-ry:
Now they're very nice people, just like you and me,
Who all have a problem, as you will soon see —
What shall they do with their garbage and trash?

All:

Why, throw it! Or bury it! Or burn it to ash!

Person 2
90,000 BC
(Monkey)

I represent people when we lived in a tree.
I get rid of my garbage so easily!
It's a snap! It's no problem — to me, or to him.
We just let it go, plop! Down through the limbs!

Props:

(Monkey masks, banana peel, orange peel)

Person 3
50,000 BC
(Cave Dweller)

I am a Cave Dweller who lives on the ground.
What do I do with old stuff all around?
Why bury it like bones, in the muck and the mire.
Or burn it with leftover skins in the fire.

Props:

(Skins)

All

Yes, throw it, or bury it, or burn it to ash!
That's how we *always* get rid of our trash!

Person 1
200 BC
(Roman)

I am a Roman who lives in the town.
Our laws won't allow me to just throw it down.
I have to drag it away for a mile
And then I can dump it, forget it, and smile!

Props:

(Roman helmet, bag of trash)

Person 2 **1200 AD** **(Briton)**	I am a Briton, wary and quick; Down on our street it can get pretty thick, When housewives above want to pitch out their goo, They just heave it out here and yell "Gardy-loo!" (Person 1 stands on chair and yells "Gardy-loo!") It will stay in the alleys until the next rain, Or until our fair London should burn down again.	1.6
Props:	(Sack of trash)	
All	Oh, what do we do with our garbage and trash: We throw it, or bury it, or burn it to ash!	
Person 3 **1630** **(Settler)**	I am the settler. I came without much, Oh, a rifle, an axle, a few tools and such. But everything else I must make with my hands. So I don't throw out much —I use all I can. Cloth scraps become quilts; I reuse my bent nails. It will be a long time 'fore the next trade ship sails.	
Props	(Pilgrim hat, quilt)	
Person 1 **1700** **(Colonist)**	I am a colonist; now life's not so tough. We have trade between cities that brings lots of stuff And some things are made by our townfolk today, I could buy a new harness, throw this old one away. We have pigs and hogs running loose in our street, If I toss it out there, they'll eat it up neat! Or I might bury it right over there. Or I could burn it; no one would care. You see, the New World is the same as the Old! We trashmakers come from a time-honored mold.	
Props:	(Coonskin hat, leather harness or belts)	
All	What do we still do with garbage and trash? Right! Throw it or bury it or burn it to ash!	

Person 2 **1890** **(Industrialist)**	I'm the industrialist and new on the scene, 1.6 I mass-produce goods with my trusty machine. This sweater, handmade, took a week, even more, But now in one hour, I can make forty-four. I make things so cheaply, you can now afford two, And throw out twice as much as you used to do.
Props:	(Engineer's cap, three sweaters: one handmade; two machine-made)
Person 3 **1950** **(Scientist)**	I am the scientist in the new post-war age. We've learned a few tricks while the war shortage raged. When we couldn't get natural stuff to process We invented synthetics to replace the rest.
Props:	(Lab coat)
Person 2 **(Industrialist)**	Rayons and nylons, acrylics and plastics For furniture and clothing and even elastics; Discard your old woolens and silks and your cotton; Real wooden toys and washboards are forgotten.
Props:	(Nylon stockings, plastic bags and containers)
Person 3 **(Scientist)**	Our new stuff will last till forever, you see Even when it's worn out to you and to me. Permanent pressed, pre-sized and pre-shrunk, When dingy and old, it's still permanent "junk." (Person 1 yells, "Junk.")
Props:	(Perma-pressed shirt)
Person 2 **(Industrialist)**	We make instant menus that come in a pack. You just boil the food in its own plastic sack. Or heat our TV dinner in its tinfoil tray It's quick; you don't wash it; just throw it away!
Props:	(Plastic bag, TV dinner)

Person 3 (Scientist)

We make lots of TVs and clothes dryers, too. 1.6
Don't ask for a trade-in; you're kidding, aren't you?

Props:

(Small broken appliance)

Person 2 (Industrialist)

Our new cars all change with each model year,
Don't try to repair them, the cost's much too dear.
Besides, we don't bother to make last year's parts
For Skylarks or Novas or Cougars or Darts.

Props

(Toy car)

Person 3 (Scientist)

It's the New Thing, the NEW that America craves.
So out, out with the old stuff, away to their graves.

Person 2 (Industrialist)

So what if there're more of us buying more goods?
So what if they won't rot away as they should?

Person 1 (Indian)

Now wait just a minute! You cannot fail
To include me in your historic trash tale.
We Indians lived simply, on prairies, in woods,
We made no high trash piles, nor mass-produced goods.
Let me be your critic, show you where you stand;
And tell you just how you're defiling our land.
Your new-fangled goods will not rot away.
When you throw them all down they remain where they lay
Then you say you will bury them deep in the ground:
All your urban trash will make quite a mound!
So then you would burn it, in smoldering masses
And fill up our air with smoke, deadly gases!
Oh, all of your answers have faults everywhere:
You'll ruin the water, the land or the air.
What's more your resources — your lumber, your ore —
Get smaller each year than the year just before.
And what's more — this old earth's not making any more.

Props:

(Indian headband)

Person 2 (Industrialist)	You're right. Our resources are shrinking away While our garbage problem grows bigger each day. We're always converting resources to refuse Instead of recycling them all for reuse!	1.6
	(Throw out cola bottle)	
Props:	(Cola bottle)	
Person 3 (Scientist)	Oh stop it! Don't drop it! We'll think of a way To make food for cows that's much better than hay. Don't burn it, return — we'll make something new, A vase for your mother, a spyglass for you. Don't bury it, carry it —back to the mill. We'll make a new blanket to ward off the chill.	
	(Pick up old quilt and wrap around shoulders.)	
Props:	(Clear bottle, flower) (Flower in bottle for vase, flower out, bottle held up to eye for spyglass)	
Person 2 (Industrialist)	It's time to progress past the Disposal Age And make recycling the popular rage! We'll have to give up old solutions for trash And all realize that its pure balderdash — to just	
All	Throw it, or bury it, or burn it to ash!	

END

DISCUSSION

The skit shows the students that people have historically gotten rid of solid waste successfully by throwing it out, burying it, or burning it. But none of these methods solves modern urban garbage problems. The discussion should attempt to reinforce this concept. One way this can be done is to discuss the characters in the skit: how they disposed of their garbage or trash and why their method of doing so was either satisfactory or not satisfactory.

Monkey:	Threw it down. No problem developed because no large concentration of monkeys existed. The garbage disintegrated.
Cave Dweller:	Threw it, burned it, buried it. These acts still did not cause a problem for the same reasons.
Roman:	Threw it. Tossing out garbage began to be a problem because many people moved to the cities, thus producing more trash than they could get rid of in the city.
Briton:	Threw it. A problem grew because more and more people moved to the cities, thus producing more trash than they could get rid of in the city.
Settler:	Had virtually no garbage.
Colonist:	Threw it, burned it, buried it. Greater trade resulted when people did not use goods until they wore out, but then discarded things began to accumulate.
Industrialist:	With a greater concentration of people in cities than ever before and more buying because machine-made goods were cheaper, much more was thrown out.
Scientist:	The big change to synthetics plus the use of enormous amounts of natural resources are causing tremendous problems.

We can't throw away our trash. There simply is no such place as "away." Care is always required to prevent our trash from having bad effects on our lives.

We can't bury it all. Not enough places are available. Besides, the modern synthetics do not rot when buried.

We can't burn it all. Some of the synthetic goods simply won't burn. Most of the burning requires expensive and often elaborate controls to prevent air pollution. And there is always ash or something left over which must be buried.

We are literally running out of some natural resources so that any form of disposal of certain goods is self-defeating.

Setting—In front of the Environmental Protection Agency (EPA) building. The air pollutants are picketing the EPA. Some carry picket signs with phrases such as "Dirty Air—Let's Keep It That Way," "Down with the Clean Air Act," and so on. TV reporters Connie Lung and Harry Wheezer are at center stage. In turn, each pollutant comes over to be interviewed, while the other pollutants continue to picket in the background.

Connie: Hi! I'm Connie Lung.
Harry: And I'm Harry Wheezer. We're here at the Environmental Protection Agency to cover a late-breaking story. Eight of the world's worst air pollutants are picketing the EPA to protest clean air legislation.
Connie: In tonight's special report, we'll give you the scoop on where these pollutants come from and the ways they can hurt people and other living things.
Harry: Our first interview is with the Particulates.
(Particulates walk over, carrying signs and chanting.)
Particulates:
Dust, soot, and grime.
Pollution's not a crime.
Soot, grime, and dust,
The EPA's unjust!

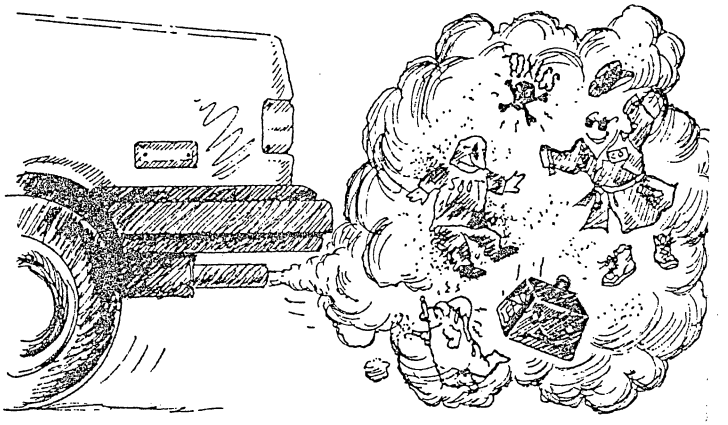
Connie: *(coughs)* So—you're the Particulates.
Particulate 1 (Soot): Yeah—I'm Soot, this is Grime, and this is Dust.
Harry: You guys are those tiny bits of pollution that make the air look really dirty?
Grime: Yeah! Some of us are stirred up during construction, mining, and farming. *(throws some dirt in air)*
Soot: But most of us get into the air when stuff is burned—like gasoline in cars and trucks, or coal in a power plant, and even wood in a wood-burning stove!
Dust: And we just love to get into your eyes and make them itch, and make your throat hurt, and—
Grime: *(interrupts)* Come on, Dust, quit bragging! We gotta get back to the picket line.

(Particulates return to picket li
Carbon Monoxide sneaks up behind Harry.)
Harry: Let's introduce the folks home to our next pollutant, Cart Monoxide. Hey, where did he g Oh, there you are! Pretty sneak Carbon Monoxide!
Carbon Monoxide: Yeah, snea up on people is what I do best. I into the air when cars and trucks burn fuel—but you can't see or s me.
Connie: Then how can we tell w you're around?
Carbon Monoxide: You'll find c when you breathe me in! I can g you a bad headache and make yc really tired. *(gives an evil laugh)*
Harry: *(yawns)* Oh—I see what mean. Thanks for talking with us Monoxide. *(yawns again)*
(Carbon Monoxide returns to picket line.)
Connie: *(checking notes)* Next we'd like you to meet some of the most dangerous air pollutants—th Toxics.
(Toxics walk over, carrying signs and chanting.)
Toxics:
Benzene, xylene, toluene,
You'll find us in your gasoline.
Don't worry, we won't make you sneeze;
Instead we'll give you lung disease.

Asbestos, mercury, and even lead,
Just breathe us and you may be dead.
Poison's what we're all about.
So you better stay clear; you better watch out!

Harry: You Toxics are made up o all kinds of poisons. How do you g into the air?
Toxic 1: Hey, man, we come fror just about everywhere. Chemical plants, dry cleaners, oil refineries, hazardous waste sites, paint factories . . .

Toxic 2: Yeah, and cars and trucks dump a lot of us into the air too. You probably don't know it, but gasoline is loaded with us toxics.
Toxic 3: Wow, that's for sure. There's benzene, toluene—all kinds of great stuff in gas.
Connie: Scientists say you cause cancer and other kinds of diseases. What do you think of that?
Toxic 4: They can't prove a thing!
Toxic 5: That's why we're here—to make sure you people don't pass any more laws that might keep us out of the air. C'mon, Toxics—we're outta here!
(Toxics return to picket line. Sulfur Dioxide walks over.)
Connie: Next we'd like you to meet Sulfur Dioxide. *(turns to face Sulfur Dioxide)* I understand you just blew in from the Midwest.
Sulfur: Hey, I wouldn't miss this for all the pollution in New York City!
Harry: I'm sure the folks at home would like to know how you get into our air.
Sulfur: Well, heck, don't they read the newspapers? I've been making the front page at least once a week! Most of the time, I shoot out of smokestacks when power plants burn coal to make electricity.
Connie: And what kinds of nasty things do you do?
Sulfur: Nasty—that's me! *(snickers)* I think it's cool to make it hard for some people to breathe. And I can make trees and other plants grow more slowly. But here's the *most* rotten thing I do: When I get way up into the air, I mix with water in the sky, and presto! You get acid rain! *(sprays water at audience)*
Harry: Acid rain is a big problem. It can kill fish and other animals that live in lakes and rivers, and some scientists think it makes trees sick. Acid rain can even eat away at statues and buildings.
Sulfur: *(proudly)* That's right. Hey, I can even travel a long way to do my dirty work. If I get pumped out of a smokestack in Ohio, I can ride the wind for hundreds of miles and turn up as acid rain in Vermont!
Connie: I sure hope we can get rid of you soon, Sulfur Dioxide!
Sulfur: Good luck, suckers! I gotta do some more picketing before I catch the next north wind!
(Sulfur Dioxide returns to picket line. Nitros walk over.)
Harry: *(to the audience)* He's really rotten!
Nitros: *(all together)* You think Sulfur Dioxide is rotten? You haven't met rotten until you've met us!
Connie: You must be the Nitrogen Oxides.
Nitro 1: Just call us the Nitros for short. *(turns to audience)* Give me an "N"!
Audience and other Nitros respond: "N"!
Nitro 2: Give me an "I"!
Audience/other Nitros: "I"!
Nitro 3: Give me a "T"!
Audience/other Nitros: "T"!
Nitro 4: Give me an "R"!
Audience/other Nitros: "R"!
Nitro 5: Give me an "O"!
Audience/other Nitros: "O"!
Nitro 1: What's that spell?
Audience/other Nitros: NITRO!
Nitro 2: What's that mean?
Other Nitros: DIRTY AIR!
Harry: Hey, I didn't know pollutants could spell.
Nitro 4: Very funny, Harry.
Connie: So, how do you Nitros get into the air?
Nitro 5: We get airborne when cars, planes, trucks, and power plants burn fuel.
Harry: And what happens once you're in the air?
Nitro 1: We can make people's lungs hurt when they breathe—especially people who already have asthma.
Nitro 2: And, like Sulfur Dioxide, we mix with water in the air and form acid rain.
Nitro 3: But we also make another form of pollution. And here she is—BAD OZONE!
(Bad Ozone waves and walks over. Nitros return to picket line.)
Bad Ozone: City life—I love it! The sun, the soot, the smell of car exhaust! It makes me come alive.
Connie: Exactly how do you "come alive"?
Bad Ozone: Well, when my friends, the Nitros, pour into the air, they get together with some other pollutants. As the sun shines on all these lovely pollutants, it heats them



(See *The Awful Eight*—p 39)

up—and creates me, bad ozone. And where there's ozone, there's smog.
Harry: *(to audience)* Smog is made up mostly of ozone.
Connie: That's right, Harry. And smog can really make city life miserable. It can make your eyes burn, your head ache, and it can damage your lungs.
Harry: But what I want to know is, if ozone is so bad, why are people worried about holes in the ozone layer?
(Good Ozone walks in from offstage.)
Good Ozone: That low-level ozone is my rotten twin sister—she's just a good gas turned bad! I'm the good ozone that forms a layer high above the earth. I help absorb the harmful rays of the sun.
Bad Ozone: *(nastily to Good Ozone)* So what are you doing here, Sis?
Good Ozone: I'm here to *support* the clean air laws. If certain chemicals keep getting pumped into the atmosphere, I'll disappear. And without me, the harmful rays of the sun will kill some kinds of plants and give many more people skin cancer and eye disease!
Harry: But what kinds of chemicals are making you disappear?
Good Ozone: It's those terrible CFCs!
(CFCs walk over from picket line.)
CFC 1: Hey, we're not so bad! People have used us CFCs to make *(point to different parts of costume)* plastic foam cups, fast-food containers, packing material, coolants for refrigerators and air conditioners—all kinds of things. *(throws "peanuts" into audience)*
CFC 2: So what if we destroy a little bit of ozone? There's enough to last for years!
CFC 3: Yeah—who needs ozone anyway?
Good Ozone: People do! Tell them what else you CFCs are doing!
CFC 4: What's Ozone complaining about *now*—global warming?
(EPA scientists walk in from offstage. Good and Bad Ozone walk offstage.)
Scientist 1: Excuse me, but did I just hear someone mention global warming?
CFC 2: Yeah. What do *you* want?
Scientist 2: We just happen to be experts on global climate change.
Connie: Are CFCs really changing the world's climate?
Scientist 1: Well, we're not positive. But over the past 100 years or so, we've poured gases, such as CFCs and carbon dioxide, into the air.
Scientist 2: And as they build up in the atmosphere, these gases may be acting like the glass in a greenhouse.
Scientist 1: That's right. They let the radiation from the sun in—but they keep the heat from getting out. And this may be causing the earth's climate to become warmer.
Harry: I've read that if the temperature goes up, sea levels may rise. Wow, some cities on the coast might be under water some day!
Scientist 1: It's certainly possible.
Scientist 2: Well, nice talking with you all, but we've got to do some more research so that we can really nail these pollutants. *(Points to CFCs. CFCs give scientist a dirty look, stick out tongues. Scientists walk offstage.)*
CFC 1: Hey, we're not even the biggest cause of global climate change. You gotta talk to another of the big pollutants about that.
Harry: (checks notes) There's only one other pollutant on the list—Carbon Dioxide.
(CFCs return to picket line. Carbon Dioxide 1 and 2 walk over.)
Dioxide 1: Did we hear you mention our name? We didn't use to be thought of as a bad gas. About a hundred years ago, there was just the right amount of us in the air.
Dioxide 2: But then people started burning things—they built power plants that burn coal and cars and trucks that burn gasoline. And they started cutting down and burning forests! Every bit of that burning releases us into the air.
Dioxide 1: As more and more of us got into the air, people started saying that the earth was warming up—because of us!
Dioxide 2: Yeah—like it's our fault! *(to audience)* The reason you're in such a mess is because you use so much fuel and cut down so many trees!
Connie: You're right, Carbon Dioxide. Maybe we should be doing a special report on people—we're the ones who are really causing air pollution.
Harry: But people can change! *(turns to audience)* How about you? Can you think of some ways that people can help fight air pollution?
(Audience responds with ideas, such as driving cars less, using less electricity, conserving forests, planting trees, and so on.)
Connie: And that's the end of our special report. The bottom line? These air pollutants are a pretty tough bunch—but people create them, and people can get rid of them. Thank you and good night.

POLLUTANT CURTAIN CALL
THE END

(See The Awful Eight—p 39)

Graphing Wrapping Paper 1.9

Objective: Students will collect data estimates from classmates and use it to create a graph.

Materials:
Trash bag
Chalk
Large drawing paper
Markers

Setting the Stage: Ask student to think about how much wrapping paper was thrown away over the holidays. Hold up a trash bag. Ask students to honestly think of the number of extra bags this size (or equivalent if they don't use trash bags) that their family threw away over the holidays. Tell student to remember their numbers.

Data Collecting:
1. Tell students to keep in their mind the number estimated.
2. Write the numbers 1-10 on the board.
3. As you say each number, ask students who estimated that number of bags to raise their hands. Fill in the number of students estimating each number.
4. When completed, ask the students how we could figure out the estimate for the whole class' extra trash.
5. Show how this can be done for two of the numbers.
6. Working in groups, have the students create a graph, format of their choice, that represents the data. Remind them that everyone will help. All names go on the graph.

Closure: Have each group stand and share their graph. Post the graphs. Lead a discussion helping students to try to imagine how many bags of trash that would be for the school, city, and so on.

What could we do to decrease this? Who is helping the Earth more, those people with the most bags or those with the least bags? (This is an important question since some children will have tried to "win" by claiming the highest number. It is important to validate those children who believe they created little trash.)

Not:e: It would be excellent to assign counting of trash bags before the holidays if possible.

SPACESHIP EARTH

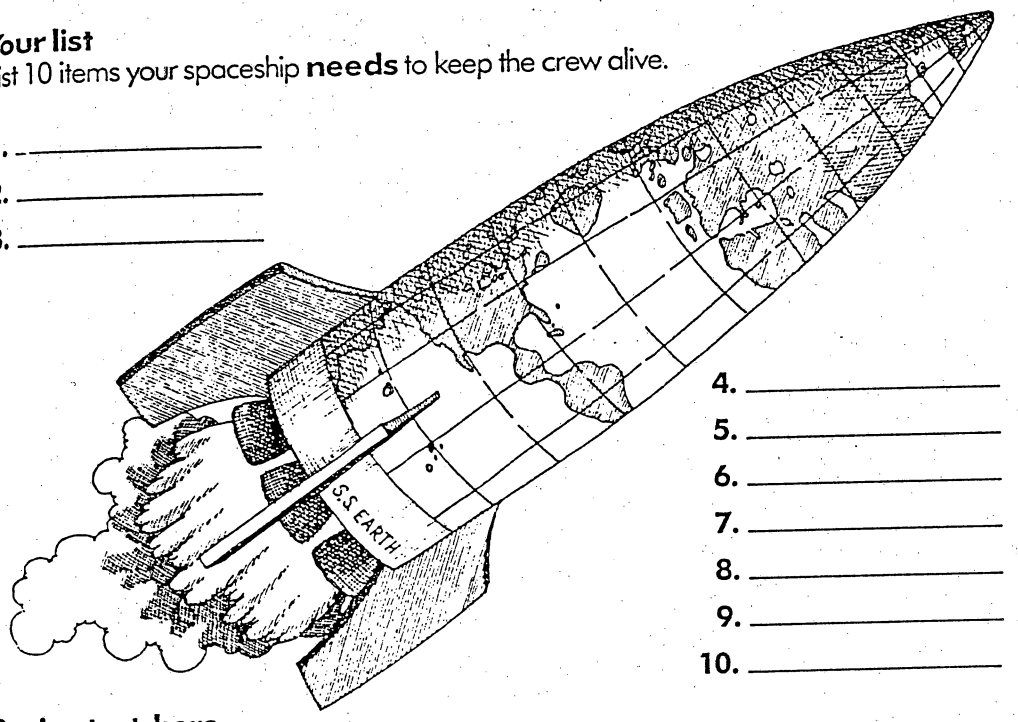
STUDENT PAGE

You are the captain of an intergalactic spaceship. Here are some things you need to think about.

Your list

List 10 items your spaceship **needs** to keep the crew alive.

1. _____
2. _____
3. _____



4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Brain stretchers

1. What's the difference between "needing" and "wanting"? On your list, circle the items you **need.** Box the items you **want.**

2. What would happen on the spaceship if air or water or food ran out?

3. How can you design the spaceship so you never run out of air, water, or food? Draw, then explain, your design on the back of this paper.

4. Is the earth like a spaceship? How?

Your rule

Think about how people on spaceships need to live. Write one rule for good spaceship living.

_____

_____

Polluting a Special Place

Purpose: To increase students' sensitivity to littering, each will create a drawing of their special place. The teacher will then add pollution and the students will discuss and write about their feelings.

Materials:
Drawing paper
Pencils
Crayons or colored pencils
Litter: Pieces about one inch square (These can be collected ahead of time and cut up by the students.)
Packing from cookies, chips, candy bars, etc. cut into small pieces
Soda bottle tops
Bits of Styrofoam
Cut up newspapers
Glue

Setting the Stage:
Ask students if they have a favorite place to visit in the out-of-doors. Have them close their eyes and picture the place. Have them spend one minute telling a partner about their place. At the end of the minute, have the partner ask any questions. Then reverse roles for one minute.

Activity:

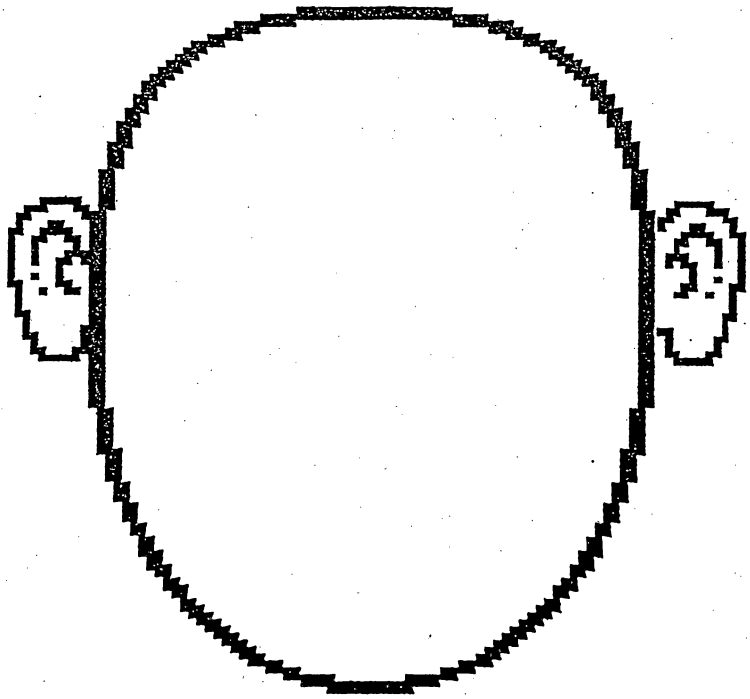
1. Pass out the paper and drawing materials. Ask the student to draw and then color their special place. The drawing should have a title explaining where or what it is. Clean up art materials, but leave drawings on desk while students go to recess.

2. While students are out of the room, the teacher will litter the drawings by gluing the bits of trash on them. This should include adding graffiti since graffiti is a form of "litter" that is plaguing cities today.

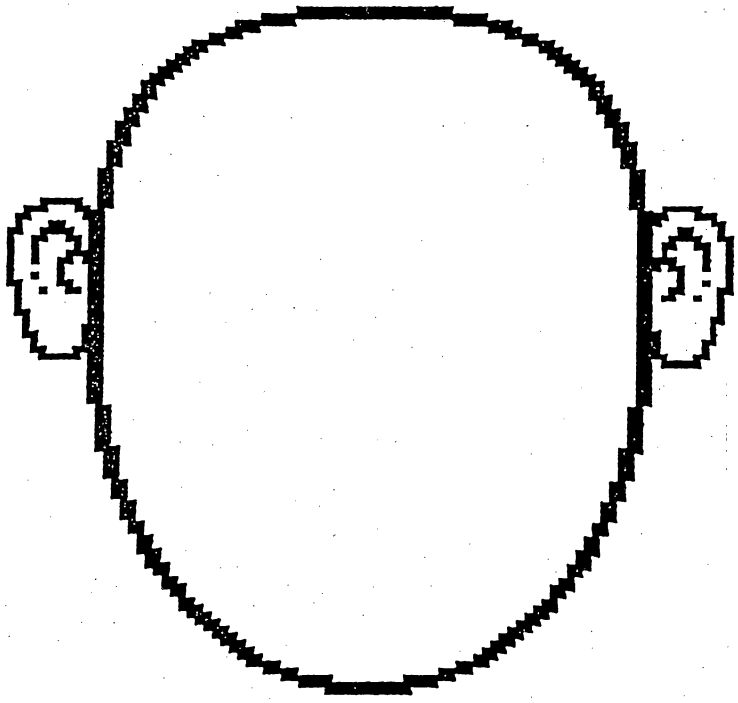
3. When students return, gauge their reactions. Ask the following questions:
How did it feel to have litter put in your special place?
Have you ever had your favorite place polluted by people?
Have you ever seen someone pollute?
Have you ever polluted a place?
After seeing your place polluted, will you pollute in the future?

Wrap-up and reflection:
Ask students to write a journal entry of how it felt to have their special place polluted.

Note: This can be a very moving lesson. Do not have other students do the littering of the pictures.



Open Mind of Walter before his dream



Open Mind of Walter after his dream

Necessary Wrappers

Objective: Students will examine the amount of packaging in a common product. They will hypothesize the need for these wrappers.

Materials: One pack of gum for every five students. Be sure it is gum with layers of packaging, as some now have less layers in more Earth-friendly packaging.

Procedure:
1. Pass out one pack of gum to each group of students so that each one has a piece of gum.
2. Tell them to unwrap the gum and make a pile of the gum and a pile of the papers wrapping the gum.
3. Which is more?

Discussion:
Why might gum need so much packaging?
What brands have less?
Can you think of things you buy with too much packaging?
Where does packaging go?
How could we show that we are against excess packaging?
What could you do to decrease packaging going to landfills?
Why do products need packaging?

Extension: Glue the wrappings onto a piece of paper to make a packaging chart. Count the number of pieces of packaging for one pack of gum. If you chewed one pack a week, how many pieces of packaging would that be in a month? Year?

Make up a slogan to help people be aware of the excess packaging on products they buy. Write it on the poster. Hang the posters around the school to show other students what you have learned.

Adapted from *A-way With Waste.*

Ranking Litter

1.5

Objectives: Students will learn which types of litter are most harmful by ranking them. Students will also state why litter is harmful.

Materials: Litter per group

paper bag	paper cup
plastic cup	glass bottle
citrus peel	cigarette butt (from a known source)
rubber balloon	metallic balloon
newspaper	6-pack ring
candy wrapper	gum paper
paper and pencil	

Procedure:

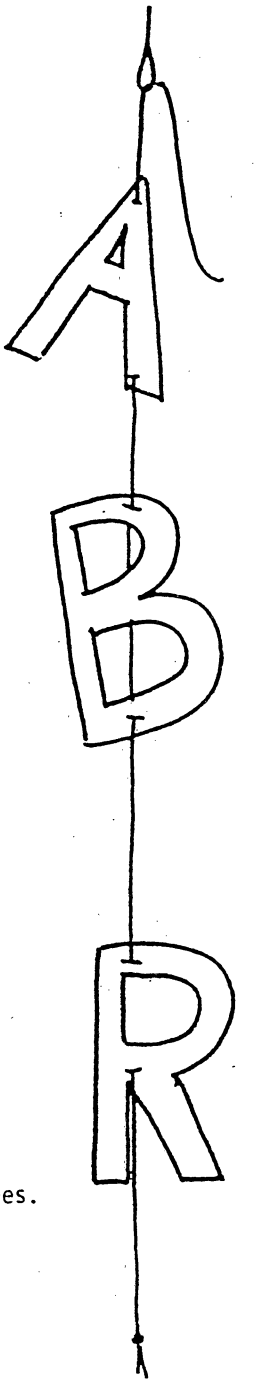
1. Place one of each item in the paper bag.
2. Give each group of students a bag, paper, and pencil.
3. Define "litter." Explain that in the bag they have "clean" litter.
4. Working as a group, students will empty contents onto their table and put the items in order from the most harmful to the least.
   a. Encourage students to discuss and explain their ideas.
   b. Tell students that they should think about harm to people, animals and the environment. Other than that, let the students make their own decisions. What is important is that they can explain their ideas and they explore possibilities.
   c. Students will be asked to explain their choices. Do not try to come to a class consensus. Commend good logic. List reasons that trash can be harmful on the board.
   d. Ask for other reasons that trash could be harmful. Included should be the following ideas:
      1. Physically harmful
      2. Harmful to public health
      3. Harmful to animals if they are mistakenly eaten.
      4. Harmful to animals if they become caught in it.
      5. Fire causing or toxic
      6. Unpleasant to look at

Wrap-up:

What could be done with all of this litter? Could some be recycled? How could they be made more safe?

Directions: Mark the circle in front of the correct word in each sentence.

1. Solar energy comes from the ○ sun. ○ Sun.
2. ○ we ○ We should not waste water.
3. Picking up litter will help keep ○ america ○ America clean.
4. The "don't pollute" owl is named ○ Woodsy. ○ woodsy.
5. Hydro power comes from ○ water. ○ Water.
6. We are trying to keep ○ california ○ California green.
7. Littering is one way we pollute the ○ earth. ○ Earth.
8. The ○ dinosaur ○ Dinosaur is an extinct animal.
9. A volcano in our state is ○ Mt. Lassen. ○ mt. lassen.
10. Smog is a kind of ○ air ○ Air pollution.
11. Not wasting paper in ○ school ○ School helps to save our trees.
12. ○ i ○ I am not a litterbug.



Environmental Beat It! Instructions

Beat It! is a fast-paced drill-type game that can be used in many curricular areas. The students love it. Time is required initially to make the cards, but they can then be kept from year to year.

Materials:

Vocabulary list or list of 35-40 questions (more than the number of students in the class) that all have unique answers.

Pencil or pen to write questions.

3 X 5 cards	Glue
Scissors	Stopwatch

Preparation:

1. On the first card glue one of the definitions or problems.
2. On the second card at the top glue the vocabulary word or answer. Below that glue the next definition or problem.
3. On the third card continue as on the second with the word or answer to the second card and another definition or problem.
4. Continue until all words or problems are used. The last card will only have a word or an answer.

Procedure:

1. Pass out definition sheet to each student.
2. As a group read through all of the definitions.
3. Pass out all cards. Some students may have two cards.
4. Ask who has the starting card (definition only).
5. Ask who has the ending card to you will know when to stop the stopwatch.
6. Say, "Go!" Begin timing on the stopwatch.
7. When the end is reached, stop the time and record it on the board.
8. Carefully collect all cards. (It won't work if even one is missing since all are sequenced.)
9. Play daily until the words are mastered. Times should usually shorten or "beat" the previous times. After about eight times I don't allow the students to use their definition sheets any longer.

Hint: If the students make an error and everyone does not get a chance to say their word, to don't play again that day.

I have the students use mental math to determine how much they beat or lost to the previous time by.

Environmental Beat It! (Glossary)

air - odorless, tasteless mixture of gases (mostly nitrogen and oxygen) that surround the Earth
aluminum - light-weight silver-white metallic element from the Earth's crust that is used for soft drink cans
bacteria - microscopic organisms that are responsible for decomposition. Some cause diseases
burning - destroying or breaking down by fire
carbon dioxide - a heavy, colorless, odorless gas in the atmosphere formed from burning fuels containing carbon. It is breathed out by animals and used by plants.
compost - decomposed matter used to enrich soil
conservation - protection of natural resources such as forests, rivers and fuels
contamination - to make impure or unsafe with harmful substances
decomposition - the process that breaks down something to smaller parts
disposable - made to be thrown away after one use or a short time
durable - able to last a long time
energy - the ability for something to do work. Oil has energy because heat given off when it is burned can be used to do work.
fuels - things that produce energy such as wood, coal, gas and oil
garbage - material considered worthless
glass - hard, brittle material formed from ash, sand and lime
greenhouse Effect - an increase in the Earth's temperature from carbon dioxide and water in the atmosphere that trap heat
green Product - a product that is not toxic and requires little energy and few natural resources to make and makes little or no toxic waste
household Hazardous Waste - products used at home that are hazardous
litter -waste materials thrown away where they shouldn't be
litterbug - someone who throws away waste where it shouldn't be
natural Resources - materials from nature needed for life such as water, wood and minerals
nonrenewable Resource - Natural resources that can run out
nontoxic - not containing ingredients that are harmful, poisonous or destructive
packaging - container or wrapping
paper - thin material made from wood, rag, or other fibrous material for writing or wrapping
petroleum - dark, oily, flammable liquid in the Earth's crust used to make gasoline and wax
plastic - material made from petroleum that can be molded
pollution - contamination of water, soil or the air by potentially harmful substances
recyclable - useful as another product after its original purpose
recycle - making waste materials into new products
renewable Resource - natural material or form of energy in endless supply, such as sun, wind, water falling, biofuels or trees
reuse - a product used more than once in its same form
sanitary Landfill - special site for disposing of solid waste on land
toxic - containing a poisonous substance that may be harmful or deadly
waste - material that has been thrown away

Objectives:

One Potato, Two Potato 1.18

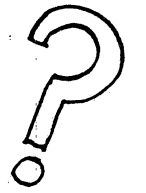
Students will be able to 1) explain concepts of production and packaging in terms of cost of product (value added); and 2) critically compare different packages and products.

Method:

Survey, discussion, critical analysis will be used to highlight the concepts presented in the activity.

Materials:

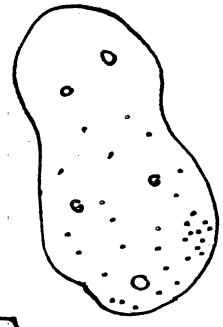
Optional: Potato survey form



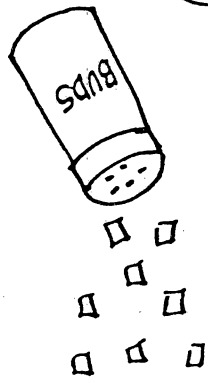
Procedure:

1. Ask the class why people buy things. Distribute the potato survey or have the students copy the column headings onto a piece of paper. Give them a week to go to the grocery store (if possible, going as a class is ideal) and look for different forms of potato in the grocery store (chips, dried, fresh, frozen, baked, etc). Record the product, the size (processed weight in ounces), the cost in cents, the price per pound (this may need to be done in class for less advanced students) and a description of the package.

2. When the students have completed the survey, have them discuss the following questions:
   - What effect does processing and packaging have on the product cost?
   - What effect does package size have on price?
   - What effect does package size have on amount of waste?
   - Are any of the packages made from recycled materials?
   - Are any of the products not able to be packaged in recyclable material?



3. Have the class decide if there are wasteful packages in the survey. Why would people buy these packages?



Going Further:

1. Have students in teams choose other fresh produce. Have the teams prepare charts for the produce they select. You may opt to have no teams duplicate their product. Encourage creativity in finding processed uses of the produce (for example, pineapple is often found dried in trail mix; many fruits are dried and in cereals).
2. Have students role play different consumers in different situations. Have one student pro and one student con the packaged material. Encourage other students to support both role players in identifying why or why not produce should be processed and packaged.

Week 2

Overview and objectives

Students will:

- Learn the 3Rs: reduce, reuse and recycle and the importance of each.
- Visualize huge numbers.
- Rank items by their rate of decomposition ability.
- Consider personal lifestyle changes that can help the Earth.

Day 1 : T*eacher background sheets* (2.1)

Language arts: 30 minutes
Read *The Old Red Rocking Chair* by Phyllis Root if available. This book can lead to a discussion of the quote, "One person's trash is another person's treasure." Discuss reusing items such as those bought from garage sales and thrift stores and the need to donate used items to charity rather than throw them away. If the book is not available, the discussion can be conducted on its own.

Math: 45 minutes
How Much is Much? (2.2) - Students learn to explain, in their own terms, what is a ton.

Math/Reading:
Science background - between 500 million and 1 billion tons of trash are generated worldwide yearly. Though the U.S. has 5% of the world's population, we generate 30% of the waste. Use these huge numbers written out fully to help students see the significance of these numbers. Then read *How Much is a Million?* by David Schwartz. This book uses concepts that are simple to help children understand huge numbers.

Art: 30 minutes
Magic Recycle Box (2.3) - This box will be covered with pictures of items that can be recycled. Then waste items will be put inside and magically turned into the recycled product. Decorate today and use tomorrow.

Homework:
What's in Our Trash (2.4) - Students predict the proportions of various solid wastes discarded by households.

Music:
Sing "25 Pieces of Trash in the Can" from *Trash Can-do* (2.8 above) is a song to help children think about taking things out of the trash can to recycle.

Day 4:

Language arts:
Read aloud *Garbage - Where it Comes From, Where it Goes* by Evan and Janet Hadingham. This will take two days. If this book is not available, request pamphlets on solid waste disposal available from most county solid waste management districts.

Science: Two 45-minute periods
Toxins Lesson Plans (2.13) - Students look at the cleaning products in their homes and learn which are toxic and which are safe. Begin today and finish on Friday. Discuss toxics and send home the toxic survey.

Math: 90 minutes
Nowhere is Away (2.14) - Students will learn what each can do to solve the solid waste problem.

Music:
Where is Away? (2.15) - by Mark Nolan of the Banana Slug String Band

Cooking: Varying preparation time and 60 minutes in the classroom
Make *The Incredible, Edible Landfill* (2.16)

Field trip, social studies, math: 45 minutes
Walk throughout the neighborhood with each child carrying a trash bag. Have them pick up all of the trash they find. When you return to the classroom, combine the bags and weigh how much litter you found in a small area in just one day.

Day 5:

Read Aloud:
The Cat in the Hat Comes Back by Dr. Seuss - As two children try to clean up they discover a pink ring in the tub. Lead a discussion looking at the book from the environmental standpoint that no matter what the children and cat try to do, the "pollution" spreads.

Video:
The Rotten Truth from 3, 2, 1 Contact is an excellent and entertaining look at trash.

Day 2:

Language arts: 60 minutes
Tell students to find a piece of trash on the playground. They will then choose one of the following ways to tell the history of this piece of trash:

- Act out a one-person play
- Write a creative history
- Draw a cartoon story
- Make a poster

Science/math: Varying preparation time. 45 minute class time.
Trash Pizza (2.5) - This is an activity where students create a pizza of items representing the solid waste that we generate. Students work with estimation and percentage as they determine the amounts of these wastes that find their way to landfills, much of which could be recycled.

Social Studies: 30 minutes
Tons of Trash (2.6) - Assign each group of students one of the dilemmas and ask them to discuss it and write down possible solutions. Have the groups share with the class.

Music: 30 minutes
Garbage Shuffle (2.7) - Rap poem

Art: 30-45 minutes
Create trash can bulletin board from *Trash Can Do* (2.8). Have students brainstorm different types of trash to put on their papers and in the can.

Day 3:

Language arts (poetry): 90 minutes
Sarah Cynthia Sylvia Stout (2.9) Mini-unit on reading/listening comprehension based on a poem by Shel Silverstein that is about a girl who refuses to take out the garbage and the consequences she suffers.

Math/science:45 minutes
How Much Trash Do I Make? (2.10) - Students see visually how much trash they create and estimate larger amounts for their class and school.

Homework:
Recycling Word Problems (2.11) - Math basic skills

Thousand Year Old Picnic - Present the *Enduring Litter* (2.12). If possible, blow up to poster size. Bring in a lunch bag filled with a typical lunch. Discuss each of the items in the bag and how long it will take to decompose if discarded in a landfill. Challenge students to determine the order of how fast things will decompose.

Is The Heat Really On?

1. Scientist 1 thinks that global warming is already underway and we need to cut carbon dioxide and CFC emissions now to slow it. Scientist 2 believes that we can't be sure yet if the world's climate is warming as a result of increased CFC and carbon dioxide levels and that we need to do more research before we take any drastic action.

2. ***Advantages:*** would help cut down on the possibility of causing further global warming; would cut down on pollution in general due to decreasing use of fossil fuels, increasing energy efficiency, and switching to alternative energy; would save money due to use of more energy-efficient appliances.
Disadvantages: would cost more in the short run to develop more energy-efficient cars, factories, and appliances; might eliminate some jobs or cut profits.

3. ***Advantages:*** would result in more knowledge about our atmosphere; would cost less in the short term; would not inflict hardships on U.S. businesses and people in developing countries.
Disadvantages: would not reduce pollution; would cost more in the long run; would increase the likelihood that, later on, it might be too late to stop the warming trend. (*Note*: Point out that the costs associated with either scientist's recommendation are difficult to estimate.)

4. A possible compromise could include making some of the changes suggested by Scientist 1 to help increase energy conservation, while continuing to do research as Scientist 2 advocated. Some scientists and policymakers support this strategy to slow the potential warming trend without threatening to harm the economies of the U.S. and other countries.

5. Opinions will vary. Point out that decisions about global climate change, like decisions about many complicated environmental issues, are often based on information that may or may not be as complete as people would like. People's values also influence their decisions.

6. It's important to stay informed about scientific issues so that you can better understand problems and can change your daily behaviors to help solve problems. For example, consumers can avoid buying products that contribute to the buildup of greenhouse gases, if they know what the problems associated with these gases are and how their actions contribute to the problems. And people can write to their representatives to encourage them to support environmental legislation.

A Look At The Facts

- Overall, average world temperatures have risen by about 1°F over the past century. But this hasn't been a constant rise. Between 1940 and 1970, average temperatures dropped.
- Developing countries are expected to rapidly increase their carbon dioxide emissions in the next 20 years, as their populations increase and they acquire fossil fuel-burning technologies.
- Cuts in carbon dioxide and CFC emissions must be made worldwide to be effective. The U.S. and other developed countries have agreed to supply developing countries with technology and funds to help them replace CFCs.
- Most scientists agree that the increase of greenhouse gases will affect the world's climate. But they're unsure about when these changes will start (if they haven't already), how much the world will warm up or cool down, what specific regions will be affected, and how rapidly the changes will take place.
- Some experts say it will take decades of research before they can be sure if the earth's climate is warming up. Others feel that we have enough evidence now.

ACTIVITY: AWAY WITH WASTE

Listen to a rhyming story to find out about sources of water pollution.

OBJECTIVES:
Describe some of the ways people pollute waterways. Describe some of the effects of water pollution.

GRADE LEVELS:
Primary and Intermediate

MATERIALS:
- *Story on page 21*
- *Drawing paper*
- *Crayons or markers*
- *Construction paper (optional)*
- *Stapler (optional)*
- *Glue (optional)*
- *Copies of page 21 (optional)*

SUBJECTS:
Science
Language Arts
Art

By listening to a rhyming story about water pollution in one community, your class can discover that the waste we wash "away" doesn't really vanish from the earth. Even waste that's out of our sight can eventually pollute someone else's water or even our own.

Before reading the story, ask the class to name some of the ways they use water (such as in drinking, bathing, brushing teeth and washing clothes and dishes). Then ask what happens to the water that drains out of their washing machines and dishwashers or gurgles down their sinks. Don't worry about whether the kids know the answer at this point. You'll be discussing what happens to household water after they hear the story. Explain that many people never think about what happens to the water they use each day or to the water that runs off their yards and streets.

Now tell the class you're going to read aloud a story about how people in a town called "Away" polluted the water in a nearby bay without realizing what they were doing. Ask the class to listen carefully to the story to find out all the ways the people polluted the bay. Also tell the class to listen carefully for the word "away." Ask the kids to make a hitchhiking sign, waving a thumb back over their shoulders (to represent something going away) each time the story uses "away."

After you read the story, discuss it with the class. Ask the children if waste from Away simply disappeared. (No.) What happened to the waste? (It ended up in the bay.) Then go over the verses in the first half of the story to be sure that the class understands what happened in each one. The information in the section "Where Did It Go?" may help with the discussion.

After the discussion, hand out drawing materials, and ask the class to draw pictures of the story. For example, someone might draw people in the town, the bay full of trash and pollution or the bay after the cleanup. An older class might want to create their own picture books of the story. Hand out copies of page 21, and ask the class to draw a picture to go along with each verse of the story. Have the kids glue their pictures onto sheets of construction paper, copy the words of each verse onto the pages and staple the pages together.

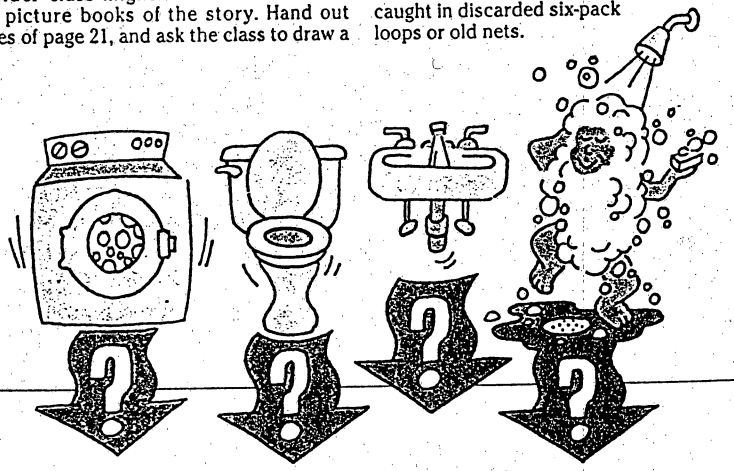
WHERE DID IT GO?:

Down the Drain. When most people in the U.S. rinse something down their drains, flush their toilets or do loads of wash, the wastewater goes to a sewage treatment plant to be purified before flowing into a bay, river or other waterway. These plants remove dirt and biodegradable material such as food waste as well as some other substances. The treatment also kills harmful bacteria and viruses. Most plants, however, can't remove all the pollutants. For example, chemicals that are used in paint thinners or rust removers pass right through some sewage treatment plants.

Off the Streets. Oil, dirt, litter and anything else that's on the streets washes into storm drains. In most areas of the country, these drains empty into a series of underground pipes that eventually dump the runoff directly into waterways.

Industrial Pollution. Factories that make chemicals, paper, medicines, steel and many other products can create a lot of pollutants. At one time, industries could legally dump all waste into waterways. Now, however, pollution-control laws limit the materials that industries can dump into surface water. These laws have greatly reduced water pollution. Still, regulations do not cover all the types of industrial waste. In addition, many experts feel that some of the regulations are not strict enough to protect aquatic systems.

Trashing the Water. When trash gets thrown overboard, it can create an ugly mess—floating in water and washing onto shore. Trash can also harm, or even kill, wildlife. Many sea birds and marine mammals die each year after eating plastic debris floating in water. Many animals also strangle or starve after getting their necks caught in discarded six-pack loops or old nets.



TRASH AND TOXICS

At present we have more reliable information about Neptune than we do about this country's solid waste stream," says William Rathje, an archaeologist at the University of Arizona. Rathje calls himself a "garbologist" because for the last 20 years he has been digging his way through America's garbage—the bags, bones, books, bottles, and other trash buried deep in landfills. And he's discovering that we have a long way to go before we really understand what happens to the trash we dump every day.

TALKIN' TRASH

Five billion tons. That's the estimated amount of solid waste Americans generate each year. *Solid waste* is whatever we throw away that is in a solid or semi-solid state. About 10-15 percent of it is *hazardous* (see definition below). But all of it can harm people, wildlife, and the environment.

Sifting Through Solid Waste: The five billion tons of solid waste we generate includes agricultural waste (mostly manure and crop leftovers), mining waste (piles of rock, dirt, sand, and slimy mining residue), and industrial waste (scrap metal, plastic, paper, sewage sludge, ash from power plants, and so on). It also includes the waste from homes, schools, hospitals, and businesses, which garbage professionals call *municipal solid waste.*

All of the waste that we throw away becomes part of the nation's *solid waste stream,* which experts say is steadily increasing. Currently, each person alone already adds about four pounds of trash to the solid waste stream every day. And if you total up what we toss, it's easy to see why we've got a solid waste crisis: We throw away enough iron and steel to continuously supply all the nation's automakers; enough aluminum to rebuild our entire commercial airfleet every three months; enough office and writing paper annually to build a wall 12 feet high stretching from Los Angeles to New York City; and enough glass bottles and jars to fill the 1350-foot twin towers of New York's World Trade Center every two weeks.*

Hazardous Nightmares: Hazardous waste doesn't fit neatly into the solid waste definition. This is waste that is flammable, corrosive, unstable, or radioactive, or that contains dangerous substances such as pesticides or lead. Although most of this waste is either itself in a solid or semi-solid state, or stored in barrels or canisters that are considered solid waste, some of it is in a liquid or gaseous state. For example, hazardous waste that pours out of factories and sewers directly into water systems and the hazardous radioactive materials that are produced by the military and by nuclear power plants are not considered part of the solid waste stream. However, both result in significant amounts of waste and create serious pollution problems.

More than 70 percent of hazardous waste is generated by the chemical industry. But small businesses and households also produce an enormous amount each year.

AWAY WITH WASTE

What do we do with all our waste? It varies, depending on the type. Most agricultural waste, for example, is plowed back into the soil. However, some agricultural waste, such as pesticides, fertilizers, and other substances, often ends up

Reprinted by permission, Naturescope Pollution: Problems and Solutions

*Source: Environmental Defense Fund

washing into water supplies where it can create serious pollution problems. Ar industrial and municipal solid waste is often dumped in landfills. Here's more abo disposal strategies that are currently in use:

Dump It! More than 75 percent of our trash ends up in *landfills*—depressions i the ground that are lined with clay or plastic and then filled with garbage. The garbag is spread out and compacted daily, then covered with a layer of dirt or plasti Although they create less of a health hazard than open dumps of the past, in whic garbage was neither compacted nor covered, landfills have their share of problem Many—especially those that have been built on wetlands, gravel pits, and other area with porous soils—are now experiencing problems with *leaching*. Leaching occur when battery acids, pesticides, and other hazardous waste leak through soils and int surface water and groundwater. Besides problems with leaching, landfills can als be expensive to operate, can create noise and visual pollution, and can caus dangerous levels of explosive methane gas to build up in the layers of compacte garbage.

Garbologists are also discovering that many of the biodegradable materials tha we've always asssumed would decompose in a landfill—don't. They've uncovere 50-year-old carrots, steaks, newspapers, hotdogs, and other "biodegradable" item that are still intact. These items haven't decomposed because oxygen, which bacteri and most other decomposers need, doesn't penetrate the compacted layers of a landfill.

Because the amount of trash we produce continues to grow and because much o it doesn't degrade, many of our landfills are filling up. And in many areas, safe site for new landfills are getting tougher to find (see page 28 for more about landfills).

Burn It! We currently burn about 10 percent of our trash in incinerators, althoug this percentage is increasing in many parts of the country. But, just as with landfills, there are pros and cons to this "up-in-smoke" method of waste disposal. Incinerators reduce the volume of trash, but they're expensive to build and operate. Incineration also creates air pollution and toxic ash residue. Much of this ash is dumped in landfills or disposed of illegally. And no matter where it's dumped, toxic ash can potentially leach into groundwater (see page 28 for more about incineration).

Recycle or Reuse It! We Americans currently recycle or reuse only about 10 percent of our waste. Although this percentage is starting to grow, our recycling efforts lag behind those of most other industrialized countries. In some areas, local governments encourage recycling by sponsoring curbside pickup of glass, metal, and paper. In other areas, citizens sort their trash and haul it themselves to local recycling centers. And in a few cities, garbage is sorted at *resource recovery plants*, where the reusable and recyclable materials are recovered, and the remaining waste is incinerated to produce energy. But so far most recovery plants have not been cost effective. As a result, many have been forced to close.

In a few areas, composting plants take biodegradable waste such as crop waste, slaughterhouse leftovers, and animal manure, and mix it with soil to create compost. The compost is then bagged and sold as a soil conditioner and fertilizer. Unfortunately, there's still not much demand for compost in the U.S.

Bury or Inject It! Disposing of acids, pesticides, dioxins, toxic ash, radioactive waste, sewage sludge, and other types of hazardous waste has become our nation's most dangerous waste problem. Most hazardous waste is dumped in landfills or

incinerated, which, as we already mentioned, creates toxic runoff and air pollution. But much has also been buried deep underground or injected into cracks and crevices of underground rock layers. Due to inappropriate storage, many of these underground hazardous materials are leaking into surrounding soils and groundwater, creating serious cleanup problems. The EPA has already identified thousands of hazardous waste sites that pose a threat to people, wildlife, and the environment. Despite the fact that laws regulating hazardous waste disposal are tougher than ever before, many hazardous materials are still disposed of illegally. And for many hazardous wastes, such as radioactive waste, there are no completely safe disposal methods.

SOLID WASTE SOLUTIONS

Most experts would agree there's no simple solution to our waste woes. But striving to reduce the overall amount of waste we produce is the first step. *Source reduction* not only reduces waste, it also saves money and conserves resources and raw materials. Source reduction means designing products that last longer and use less packaging. It means producing and using fewer hazardous products. It means buying only what you need and selectively buying the most environmentally sound products. And it means throwing away the "throwaway" mentality.

But even with an increased focus on producing less, we'll always have waste. And many experts agree that an *integrated waste management* approach is best—one that focuses on source reduction in addition to recycling and safe incineration and landfilling.

Let's Hear It for Recycling: Reusing and recycling what we've traditionally tossed makes economic and environmental sense. By not burning or dumping as much waste as they have in the past, communities and businesses are saving money and conserving resources.

Although most people are behind recycling efforts, some environmentalists are worried that some recycling programs may discourage source reduction and encourage the use of environmentally damaging products. For example, many environmentalists do not support certain plastic recycling efforts because they feel it encourages plastic use. They feel that the benefits of recycling do not justify producing more plastic in the first place because plastic manufacturing uses fossil fuels and creates toxic by-products. On the other hand, some environmentalists support plastic recycling research because they feel that plastic products are here to stay and plastic recycling will save landfill space, eliminate plastic incineration, and encourage the recycling habit.

High-Tech Solutions: Well-designed and safely sited landfills, efficient resource recovery plants, and other high-tech but environmentally sound operations should also be a part of the solution to our waste problems. But even though new discoveries can help design safer landfills and recovery plants, many environmentalists caution people against counting on technology to solve all our waste woes. Often technological "fixes" don't work as planned and can create new environmental hazards that are more damaging than the problems they were meant to solve.

The Secret of Success: A successful integrated waste management program has one more key component—education. An educated public knows what happens to its waste. An educated public keeps abreast of innovative laws that encourage recycling, such as bottle bills and packaging taxes. An educated public is on the lookout for advertising scams like those that try to sell "degradable" plastics that don't really degrade. And above all, an educated public realizes that as far as waste goes, "less is definitely best!"

There is no single, simple solution to our communities' solid waste problem. To effectively reduce solid waste management problems, communities need to consider a hierarchy of *integrated waste management* techniques. The term "integrated waste management" refers to the complementary use of a variety of waste management practices to safely and effectively handle municipal solid waste with the least harmful impacts on health and the environment. The hierarchy consists of three levels: first, source reduction; second, recycling; and third, combustion and landfill.

At the top of the hierarchy is *source reduction*, or reducing both the amount and the toxicity of the waste we generate. Manufacturers may contribute to source reduction by designing and manufacturing products that contain fewer toxics and less packaging. As consumers, we can use our buying power to select more durable and nondisposable products, products that have more than one "life," and those with less packaging and fewer toxic components. One of the best ways to lessen our waste disposal problems is to reuse many of the things we have habitually thrown out.

Recycling, including composting of food and yard waste, is the next tier of the hierarchy. Widespread recycling efforts prevent potentially useful materials from being placed in landfills or combusted, thus preserving our limited capacity for disposal. Reuse of materials also saves energy and natural resources. It is good for American business and can help the economy. For example, aluminum cans, paper, and used oil (among many other items) can be reprocessed to make new products. The emphasis in "Let's Reduce and Recycle: Curriculum for Solid Waste Awareness" is on source reduction and recycling.

Waste combustion and *landfill* are next in the hierarchy of integrated waste management. Combustion reduces the bulk of municipal waste, while providing the added benefit of energy production. Source reduction and recycling can make combustion and landfill safer and more efficient by reducing the quantity and toxicity of the waste and removing recyclables that may be difficult to combust or may cause potentially harmful emissions.

Landfill will continue to be the major method of solid waste disposal for the near future. It is needed to handle waste that cannot be recycled or safely combusted. Also, residual ash from waste combustion must be disposed of in specially designed landfills. It is likely that there will always be some portion of waste requiring landfill no matter how efficient our reduction, recovery, treatment, and recycling processes become. We can, however, greatly reduce this portion by becoming aware of our own individual contributions to the solid waste problem and modifying our habits to promote wise use and reuse of our valuable resources.

It is no longer possible to hide the "garbage crisis" from the public eye. It threatens to weaken our cities and consume valuable portions of our natural resource base. The cost to communities of handling increasing quantities of solid waste diverts public funds from other important needs such as education and police and fire protection. The school system is an invaluable tool for increasing public awareness of this problem. Teachers are in an excellent position to enlighten our younger citizens about how solid waste problems relate to them, and how they can contribute to a solution.

How Much is Much?

Objectives:

Students will be able to 1) explain in their own terms what is a ton and other amounts; and 2) discuss relationships of volume.

Method:

Students are challenged to turn concepts of large numbers into "real things" by creation of examples.

Materials:

Scales, paper, scissors, pencils, blocks, chips, coins, marbles and anything in the classroom!

Procedure:

1. This activity can be used in any lesson where content presents concepts of large numbers.
2. In solid waste, we often talk about tons. For example, we can say that in our state, so many million tons of waste was landfilled in one year. But how much is a ton in concepts that we can understand?
3. Discuss the concept of a ton. If a ton is 2,000 pounds, what is a pound? Have students form teams of three. Each team is to choose some small item in the room. The team should weigh that item and record its weight.
4. How many of those items will it take to make a pound? Gather that many items.
5. Show how many of each team's items it takes to make a pound by a drawing.
6. Have each team collect as many of its items as the team can. How many did they get? How many pounds would that be?
7. Have each team prepare a visual presentation for the rest of the class on the weight of their item and how many items it will take to make a ton.
8. Use this same approach to discuss million or billion.

Magic Recycle Box

Objective: Students will choose recyclable materials and then learn some of the products made from recycled materials.

Materials: **Box making:**
Box approximately 12" X 18" X 24"
Sign for the box that says, "Magic Recycle Box" Glue
Magazines Scissors Drawing paper
Crayons, markers, colored pencils, pencils

Items to Recycle: Slices of trash pizza or pieces of trash from each of the different solid waste groups - see *Trash Pizza*

Recycled items:
Recycled paper
Aluminum can (Can be made into another can because processing is hot enough)
Glass bottle (Can be made into another bottle because processing is hot enough)
Carpeting, tennis ball (covering),Scotch Brite scrubbing pad (made from plastic fibers)
Compost (From yard and food waste)
Picture of plastic dog house, patio furniture, etc. made from recycled plastic
Bottle of motor oil

Procedure:

A. Making the box:
1. Cut an opening on the side or the top of the box that pieces of the trash pizza or recyclable items can fit through.
2. Have students color the sign and glue it onto the box.
3. Students search through magazines or draw and color their own pictures of items that can be recycled.
4. Glue pictures all over the box. (If you don't have enough time to cover the entire box, keep it until next year when new students can add to the collage.)

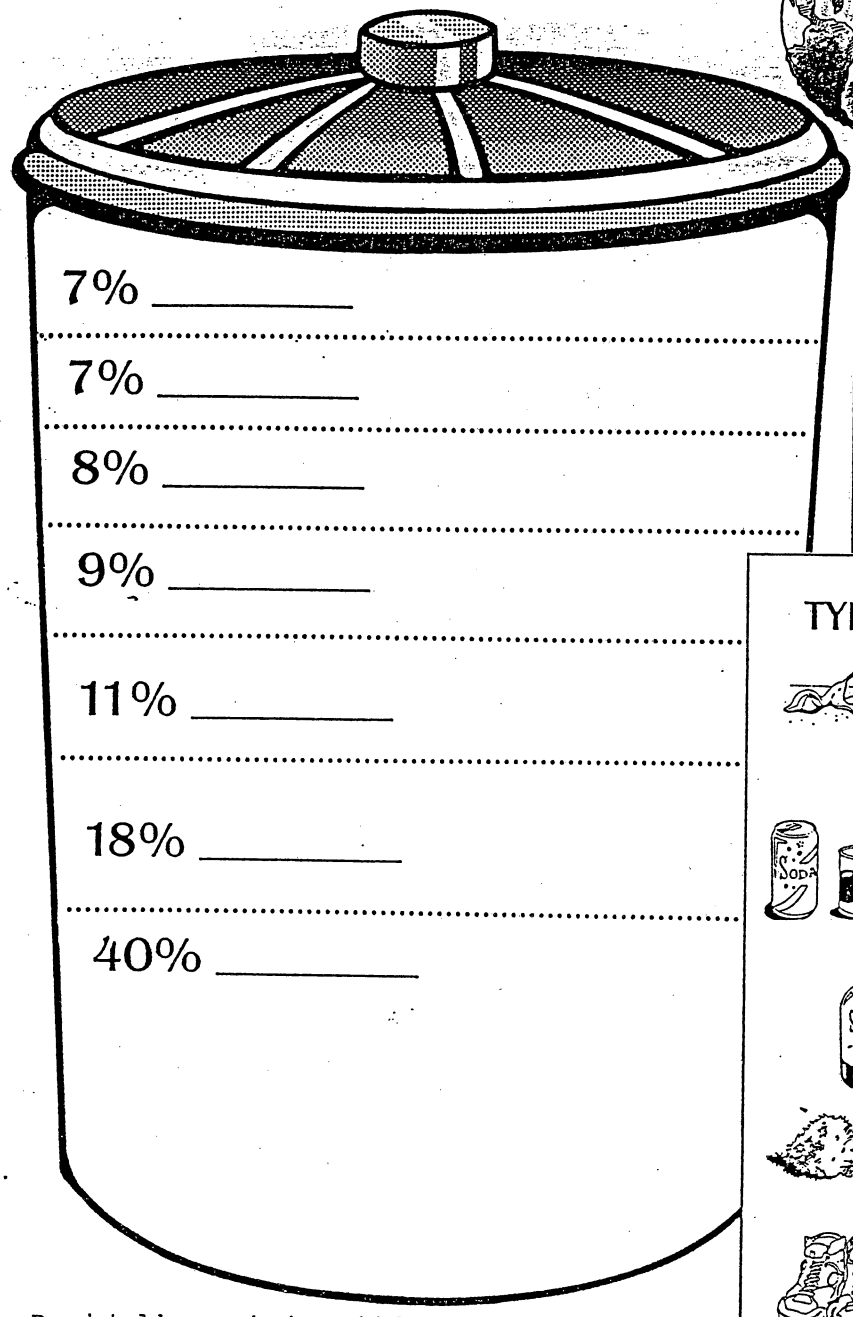
B. Making the magic:
1. Prior to using the box, place the recycled items in the box.
2. With great flourish, place one of the items to recycle in the box and pull out one or more of the items it can be recycled into. The students will enjoy this most if you really pretend to be a magician.
3. Continue with all of the other garbage items. Only the "other' containing the rubber, wax, etc. cannot readily be recycled.

Follow-up discussion and assessment:
Is recycling really magic?
What can we recycle in our city?
Why do people recycle? Why don't people recycle?

WHAT'S IN OUR TRASH?

2.4

Directions: Place the name of each type of trash in its proper section of the trash can. At home, list items from your trash in their proper sections.



THINK EARTH
Environmental Education Program
★ Waste Reduction Unit

NAME: _____

DATE: _____

TYPES OF TRASH

food waste

glass

metal

paper

plastic

yard waste

other
(wood, rubber, cloth, etc.)

(Source: Characterization of Municipal Solid Waste in the U.S.: 1990 Update; U.S. EPA. Percentages by volume.)

Trash Pizza

Objectives: Students will learn the composition of solid waste, classify solid waste, and see the proportions of various components of solid waste.

Materials: One crust is required for each group. If time is at a premium, cardboard circle or paper plates can be used instead of the crust. But the crust makes it much more realistic and fun. **Ahead of time** make the pizza crust. One crust is made as follows:

Utensils: Bowl, spoon, rolling pin, and pizza pan
Dough: 2 C. flour, 2 C. salt, 1 C. water mixed together Take 3/4 and roll it out on a greased pan. Take the other 1/4 and roll it into a long snake. Place around the pizza edge like the crust edge.
Cut dough into 7 pieces, the proportions as listed below in procedure 1.
Bake at 350° for 10-15 minutes. Every five minutes open the oven and recut the pieces. If you don't do this you will never be able to cut the pieces after they are baked.
Sauce: Mix white glue and red food coloring. (It will be pink). Brush on pizza crust and place in broiler for 2-3 minutes. Place dough in empty pizza box.
Trash: small bits of the following types of items: paper, grass clippings, glass (Marbles work well), rubber bands, wax (candles), leather, foil
Glue that dries clear
Worksheet

Procedure with the students:

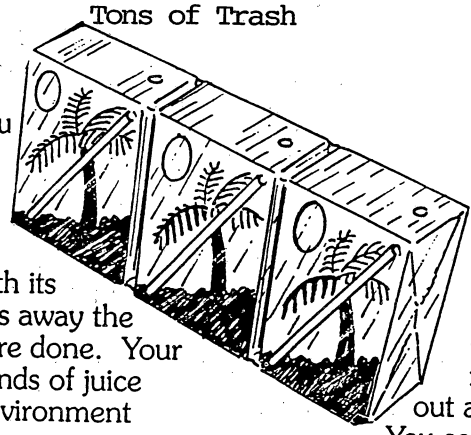
1. Pass out the worksheet and ask students to try to match up the item with the percentage it is in our solid waste. Then, on the board write a list of the approximate percentages of items in our solid waste. These are as follows:

40% - Paper	18% - yard waste
9% - metals	8% - Plastic
7% - glass	7% - food waste
11% - other	

2. Pass out small bags with a variety of the trash items in them for each group. Pass out one crust per group.
3. Instruct students to sort the items.
4. Once sorted, the students must agree which slice of the crust is for each item.
5. Glue the items on the appropriate slice with white glue that dries clear.

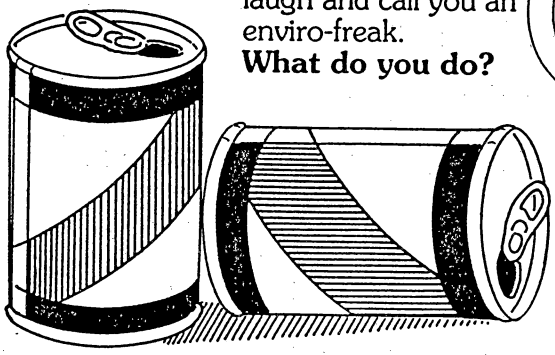
Closure: Tell students that this is all of the trash that goes to our landfills. Is there something we could do besides sending it to the dump? Students should suggest using less, reuse or recycle it. This leads into the *Magic Recycle Box* and *Trash Relay* activities.

Draw names for who gets to keep the trash pizzas. Spray shellac will help to preserve the pizza.

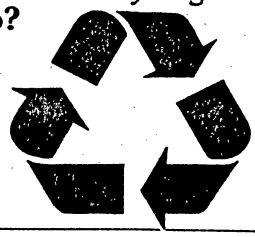


1. Every day for lunch you bring an individual-sized carton of juice that comes wrapped in a handy three-pack. Each carton is easy to carry and comes with its own straw, and you can toss away the empty container when you're done. Your friend tells you that these kinds of juice packages are bad for the environment because they create a lot of unnecessary waste and the materials can't be recycled.
What do you do?

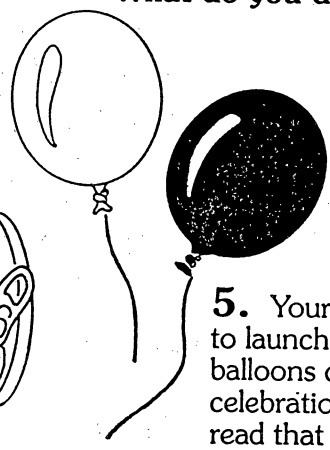
2. At the end of a picnic, your friends start throwing their soda cans into the trash—even though there's a recycling container nearby. When you say something about it, they laugh and call you an enviro-freak.
What do you do?



3. You know that the waste problem is serious, and you think recycling is important. But your parents don't seem to have much interest in recycling.
What do you do?



4. Your favorite music group just put out a new compact disc. You see the disc hanging on a display rack at the record store. But you notice it's wrapped in a lot of extra throwaway paper and plastic.
What do you do?



5. Your school is planning to launch hundreds of balloons during a special celebration. You've recently read that released balloons can cause problems for wildlife, especially if the balloons land in the ocean. That's because sea turtles and other animals often mistake the balloons for food. When these animals swallow the balloon scraps, the plastic can block their digestive system and cause them to starve.
What do you do?

(See Tons of Trash—p 24)

GARBAGE SHUFFLE

Chorus
Do the garbage shuffle; it's an age-old thrill—
'Cause we all make garbage, and we always will!

1: Now I bet you're askin', bet you're dyin' to see
What a hip hippo hunter from prehistory
Does with garbage! (clap) . . . like old tools of stone—
All that garbage! (clap) . . . like those animal bones.
Well, I throw 'em, I toss 'em, I drop 'em at my feet.
Then I move my camp and go hunt more meat.

2: I'm a wise orator, I'm an ancient Greek.
I was born to talk, and I love to speak
About garbage! (clap) . . . it used to fill our roads—
All that garbage! (clap) . . . now we take it in loads
'Bout a mile beyond our city's limit.
Now our homes and streets aren't buried in it.

3: Now you might be askin' why a British maid
From the Middle Ages would be afraid
Of garbage! (clap) . . . out the window we throw
All our garbage! (clap) . . . to the street below.
Well, our city's so crowded that all of that trash is
Making us sick and giving us rashes.

4: I'm a Spanish explorer and here's what I love:
It's a sailing ship that isn't full of
Garbage! (clap) . . . who wants a messy boat?
All that garbage! (clap) . . . it's tough to stay afloat.
So I toss my trash out into the sea,
Where it disappears and never bothers me.

5: It's the 1860s. I'm a germ detector.
I'm a New York City health inspector.
I hate garbage! (clap) . . . the alleys flow with trash—
All that garbage! (clap) . . . the water's full of ash.
Now those garbage fumes—they can make you ill,
So it's time we cleaned up what we spill.

6: In the Roaring Twenties you would be a grump
If you lived, like me, near an open dump.
It's all garbage! (clap) . . . full of bugs and flies—
In the garbage! (clap) . . . the rats are monster size.
The trash is so high that people say
We'll have garbage mountains 'round here someday.

7: Now we're in the Depression, and some folks feel
That incinerators are the way to deal
With garbage! (clap) . . . it all goes up in smoke—
All that garbage! (clap) . . . but I cough and choke
On the cloudy fumes that fill the air.
I just wish that I could move away somewhere.

8: It's the age of plastics; it's the age of ease.
I'm a '60s chemist, and I'm very pleased
With garbage! (clap) . . . plastic cups, paper plates
In the garbage! (clap) . . . disposables are great.
We've got landfills now to store this waste,
What we throw away can just be replaced.

9: There's an oil crisis, and I have to brag,
'Cause I think I've fixed the biggest snag
With garbage! (clap) . . . 'cause the trash can burn—
All that garbage! (clap) . . . can make a turbine turn.
We'll make energy from our piles of trash.
The only problem will be the toxic ash.

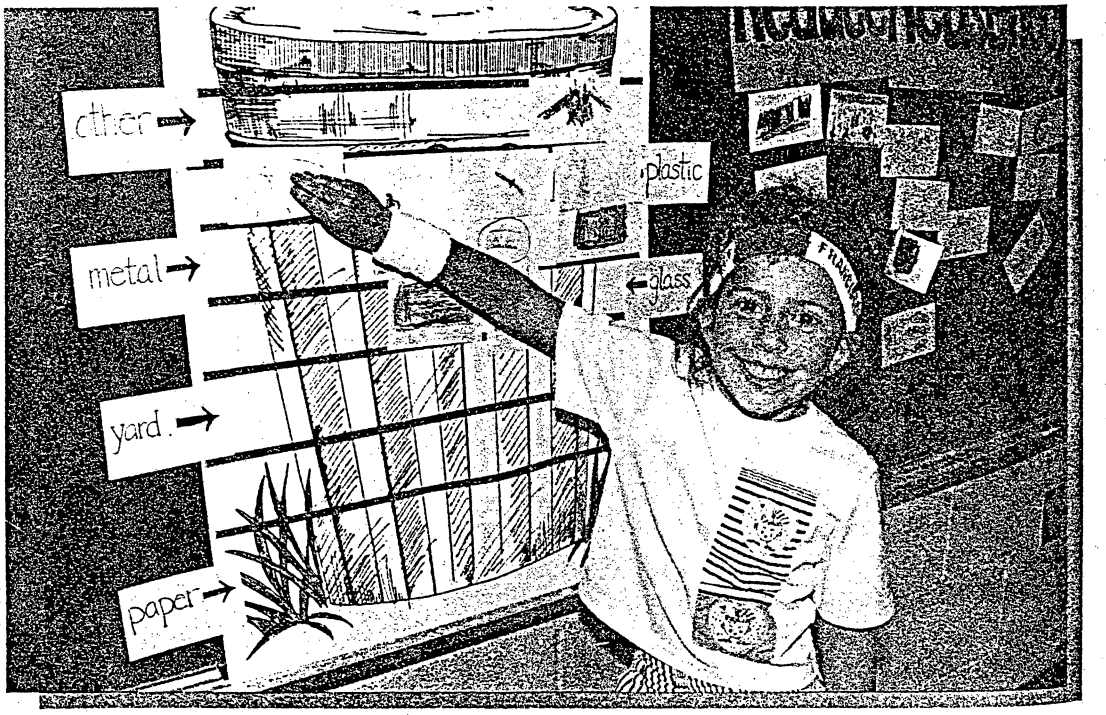
10: I'm your average kid, and I have to say
That I've found an awesome, cleaner way
With garbage! (clap) . . . I try to make much less—
All that garbage! (clap) . . . I'm tired of all this mess.
Now I reuse, recycle, make a compost pile—
It's the garbage shuffle, 1990s style!

Trash Can Do

TRASH IN THE CAN 2.8

(Sing to the tune of "99 Bottles of Beer on the Wall.")
25 pieces of trash in the can,
25 pieces of trash.
Take one out,
And then you can shout:
24 pieces of trash in the can!

Practicing the following tips not only cuts down on the amount of trash people generate, but also saves resources and energy:
REDUCE trash by not buying overpackaged products, disposable products, or products that you don't really need. Also repair broken objects or mend torn clothes instead of throwing them out.
REUSE whatever you can, such as the backs of paper for scratch paper, empty containers for storage, and old cloth for cleaning rags. And you can give away clothes you outgrow, books you've read, and toys you no longer want so someone else can use them.
RECYCLE whatever you can. For example, many communities collect glass, aluminum, newspaper, and some plastics to make into new products. You can also recycle food scraps and yard clippings by making a compost pile.



Tim Farnham

Sarah Cynthia Sylvia Stout
Reading and Listening Comprehension

2.9

Objective: Students will use a piece of popular literature to exhibit their reading and listening comprehension.

Materials: Copies of the poem for each student
Pencils
Crayons

Procedure:

1. Students will silently read poem silently.
2. The class will discuss the poem as a whole.
3. Students will complete the worksheets looking back at the poem as needed.
4. As students finish have them draw a picture of Sarah's house.

Reading/Listening Comprehension

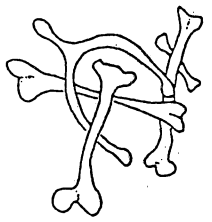
(Primary Level)

Below is a poem about Sarah Cynthia Sylvia Stout and how she acts and feels about garbage! As you listen to your teacher read the poem out loud, fill in the worksheet or raise your hand as you **hear** the words that fill in the worksheet. Start with words that rhyme then do it again until you have filled in most of the sheet.

Sarah Cynthia Sylvia Stout
Would not take the garbage out!

She'd scour the pots and scrape the pans,
Candy the yams and spice the hams,
And though her daddy would scream and shout,
She simply would not take the garbage out!

And so it piled up to the ceilings:
Coffee grounds, potato peelings,
Brown bananas, rotten peas,
Chunks of sour cottage cheese.



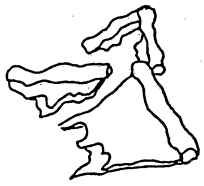
It filled the can, it covered the floor,
It cracked the window and blocked the door
With bacon rinds and chicken bones,
Drippy ends of ice cream cones,
Prune pits, peach pits, orange peel,
Gloppy glumps of cold oatmeal,
Pizza crusts and withered greens,
Soggy beans and tangerines,
Crusts of black burned buttered toast,
Gristly bits of beefy roasts. . .

The garbage rolled on down the hall,
It raised the roof, it broke the wall. . .
Greasy napkins, cookie crumbs,
Globs of gooey bubble gum,

Cellophane from green baloney,
Rubbery blubbery macaroni,
Peanut butter, caked and dry,
Curdled milk and crusts of pie,

Moldy melons, dried-up mustard,
Egg shells mixed with lemon custard,
Cold french fries and rancid meat,
Yellow lumps of Cream of Wheat.

At last the garbage reached so high
That finally it touched the sky.



And all the neighbors moved away,
And none of her friends would come to play.

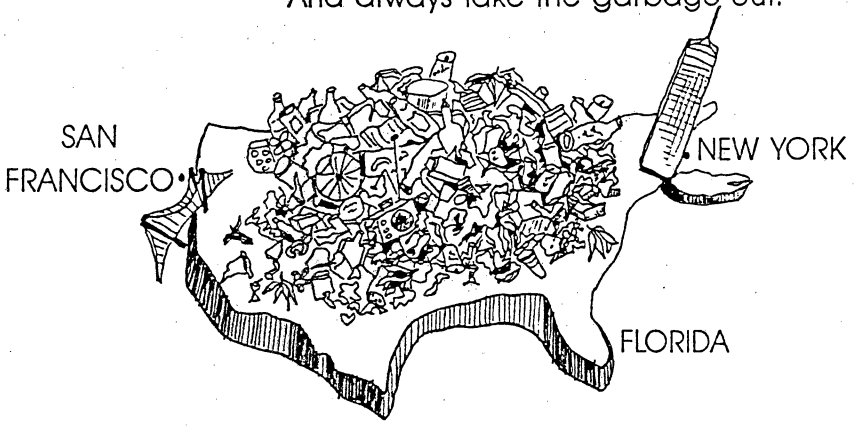
And finally Sarah Cynthia Sylvia Stout said,
"OK, I'll take the garbage out!"

But then, of course, it was too late. . .
The garbage reached across the state,
From New York to the Golden Gate.

And there, in the garbage she did hate,
Poor Sarah met an awful fate.

That I cannot right now relate
Because the hour is much too late.

But children, remember Sarah Stout
And always take the garbage out!



B. Read the poem and answer the following questions. **Circle** the **best** answer.

1) Sarah Cynthia Sylvia Stout hates
   - a. garbage
   - b. food
   - c. school

2) She is very
   - a. smart
   - b. lazy
   - c. silly

3) Most of the garbage is made of
   - a. dead leaves
   - b. old clothes
   - c. rotten food

4) The garbage is so bad that it
   - a. is taken to a dump
   - b. piles up to the sky
   - c. burned and buried

Fill in the missing word . . .

6) When Sarah would NOT take the garbage out, her father _____ and _____.

7) The messy food filled the _____ and _____ of the floor.

8) Two kinds of fruit that were rotting were _____ and _____.

9) A word that means bad or rotten meat is _____. 2.9

10) The garbage spread from _____ State to the Golden Gate.

C. Write one or two sentences to answer the following questions:

1) What is Sarah Cynthia Sylvia Stout's problem?

_____

_____

_____

_____

_____

_____

_____

2) List ten (10) things that mean garbage in the poem.

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

2.9

3) What happens when Sarah Cynthia Sylvia Stout won't throw the garbage out?

4) What kind of person do you think she is?

5) Why is it important to help with the garbage?

How Much Trash Do I Make?

Objective: Students will visually see how much trash an average person creates. Students will use math skills and estimating.

Materials: large garbage bag full of "able-to-be-handled" trash
large box (approximately 2 feet square)
scale to weigh box of trash(baby type works best)

Procedure:
1. Weigh the box empty.
2. Have students estimate how much of the box will be full when it contains 3.5 lbs of trash.
3. Have students take turns placing pieces of trash into the box until it reads 3.5 lbs. Explain that this is the amount of trash thrown away by the average American at home in a day. Does that mean that this is the amount at your home?
4. Have students continue to add trash until the scale reads 5.5 lbs. This is the average amount created per person in this country if we count the trash created by restaurants, industry, businesses and the government in a day for each person.
5. Measure the height of the box of 5.5 lbs. How tall would the boxes of trash be for the class for one day?
6. Estimate for all of the students in the school for just one day.

Extension: Figure out how man tons of trash the class would generate in one year.
7. A ton equals 2,00 pounds. How many students together will equal one ton?
8. Then calculate how much trash these students create in one day.
9. How much trash does the class create in a year?
10. Divide by 2,000 lbs. to see how many tons that is.

(To compare this to trash going to landfills and football fields, see *Nowhere is Away* (2.14) procedure 5.)

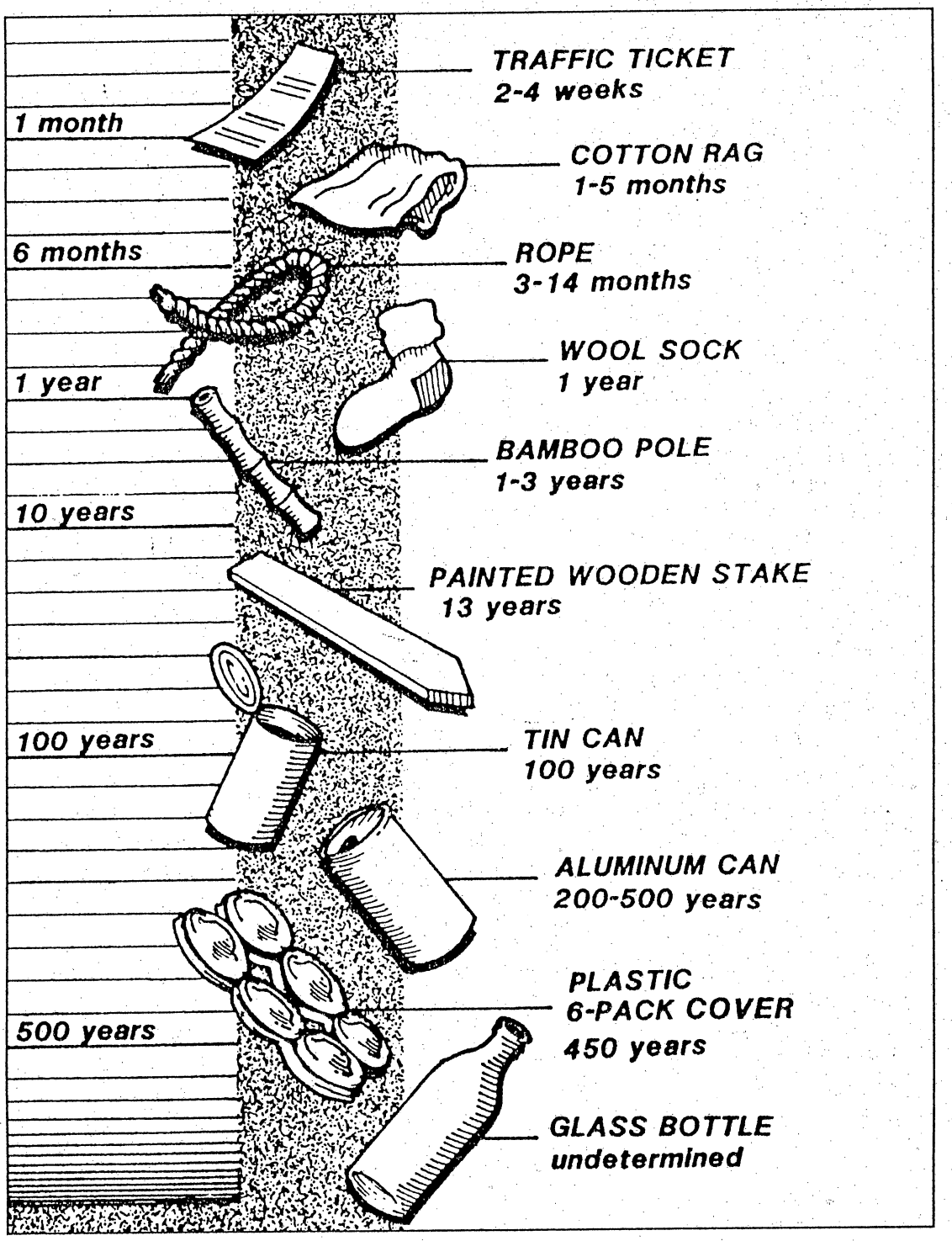
Discussion: Do you think people in other countries have more or less trash per person? Why?
What do you think will happen in the future?

Closure: What could you do to create less trash at home? At school? (Reduce trash, reuse, or recycle items.)

Enduring Litter

2.12

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



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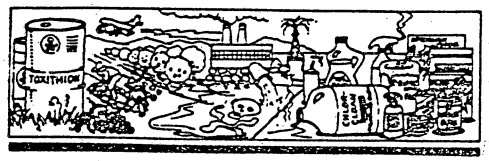
TOXICS LESSON PLAN—GRADES K-6



SUMMARY OF ACTIVITY:

Students survey themselves and their families to find out attitudes and beliefs about toxics.

Time: Two 45-minute periods, with time in between to complete survey.

Setting: Classroom, home

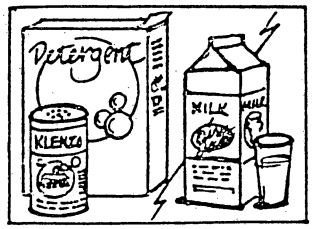
Materials:

- Four or five cleaning products that are potentially toxic (see Preparation and Lead-up).
- Several copies of Home Toxics Survey for each student (see Preparation and Lead-up).
- Butcher paper and marking pens.

BACKGROUND INFORMATION:

A toxic is any substance that is capable of harming a person if ingested, inhaled, or absorbed through any body surface. Toxic substances vary widely in the types of harm they cause and the conditions under which they become harmful. The effects of toxic substances vary widely, too. Acute reactions such as vomiting or dizziness as well as chronic reactions such as decline in mental alertness, changes in behavior, cancer, and mutations that can harm unborn children of exposed parents are possible. Because toxics can cause both acute and chronic reactions, they are a broader category than poisons, which produce acute reactions only. For this reason, the words *toxic* and *poison* are not interchangeable.

Nobody is "for" toxic chemicals in the sense of wanting to endanger ourselves and others, and yet many toxic substances seem to be a necessary part of our lives and have come to be considered essential in our homes, our workplaces, and our schools. This predicament or needing substances that sometimes produce undesirable side effects forces people to make choices about what is acceptable to them. Different people are willing to take different risks related to toxics and have varying concerns about the effects of toxics on themselves and people around them. Some people know that many of the products they use are potentially toxic but consider the risk worthwhile. Others try to avoid toxics and thus sacrifice the benefits of certain products.



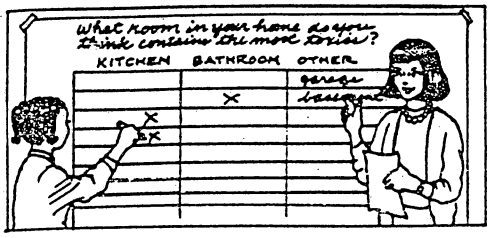
We do not know exactly how many households in our society use commercial cleaning products, but the number is quite high. In a survey conducted in the Seattle area, 97.5 percent of the respondents said they had household cleaners in their home. In a 1979 consumer survey of the most-used items sold in supermarkets, soaps and detergents topped the list, and other cleaning products such as scouring powders and air fresheners were bought by more people than staples such as milk and butter.

Many people do not know that household chemicals can be quite toxic. Most of the dangerous substances in the home are found in cleaners, solvents, pesticides, and products used for automotive care. In question number three of the copycat page, "Finding Out About Toxics," all of the items listed except salt and baking soda are toxic.

In this activity students survey themselves and their families to find out attitudes and beliefs people hold about toxics. Older students are also introduced to the terms *toxic*, *risk*, and *benefit* (a risk is a possible danger; a benefit is an advantage).

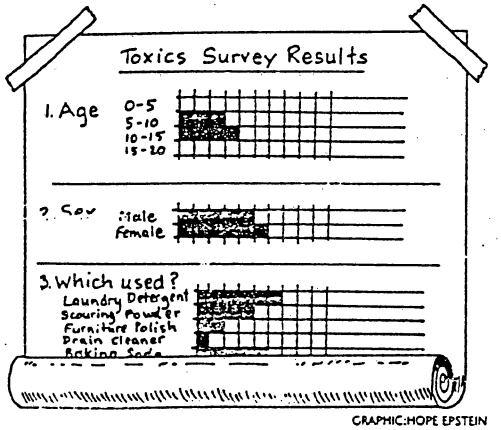
PREPARATION AND LEAD-UP:

For grades K-3: Prepare a butcher paper chart for the wall like that in the example shown on the top of the following page.



During the activity each student will answer the survey questions. Later, for a home learning activity, students interview family members. Make enough copies of the Home Toxics Survey so that each student can conduct the home surveys.

For grades 4-6: Collect four or five familiar cleaning products. Tape the lids on so that students cannot open the containers. Prepare a chart on butcher paper titled "Toxics Survey Results" that students can use to record the results of their surveys. The chart should list all of the survey questions and allow space for recording the responses.



GRAPHIC:HOPE EPSTEIN

Prepare copies of the Home Toxics Survey, one per household.

ACTIVITY FOR GRADES K-3:

Day One

1. Introduce students to the Home Survey by posing survey questions 1-6 to the class and listening to their responses. Based on their responses, modify the survey so students are gathering responses to only those questions which they seemed to understand. Explain that a survey is a set of questions with no right or wrong answers; surveys allow us to find out what different people think about the same questions.

2. Tell the class that they will be taking home the same set of questions that they have just answered in class. Tell them that they should ask each member of their family to record their individual responses on a separate sheet and share their responses verbally with the child. Ask the students to bring the surveys back to school the following day.

Day Two

Compile the results of the survey for discussion (see discussion questions) by using the graphing suggestions under Preparation and Lead-Up.

Discussion Questions:

What does "toxic" seem to mean to the people we surveyed?

All of the items in question number three except salt and baking soda contain toxic ingredients. Did the people we surveyed know this?

Do most people seem to agree about when it is okay to use toxics? If not, why do you think people have different ideas about this?

Did members of your family answer the questions the same way as you and as each other?

What else did we find out?

Was there anything that surprised you?

ACTIVITY FOR GRADES 4-6:

Day One

1. Introduce the activity and the unit by displaying the household products you have gathered. Ask students, "What are these things? What are they used for? What do we know about them? Is there anything dangerous about using them? What don't we know about these things that might be important to know?" Tell students that over the next two days they are going to be learning about some of the possible dangers of things that are called toxics. Say, "In order to find out more about what we as a class think about toxics, we are going to take a survey."

2. Hand out one Home Toxics Survey to each student and explain that the survey is not a test, students do not need to write their name on the survey, and there are no right or wrong answers. Give students a few minutes to complete the survey.

3. Divide students into groups of four. Have each group discuss the following questions using the survey:

- What are toxics?
- Where do we find toxics?
- Who uses toxics? Why?
- Are we always aware of the presence of toxics?

4. Have groups share with the class their responses to these questions. Accept all responses; do not provide answers at this point. This is a time for students to begin thinking about toxics and for you to assess their initial understanding and attitudes. Talk with students about the idea that nobody is "for" toxics but that most people think these substances are a necessary part of their lives. Tell them that some people know many of the products they use are toxic yet consider it beneficial to continue using them, while other people try to avoid toxics by using an alternative or doing without certain products altogether.

5. Introduce the words *risk* and *benefit*. Help students discuss the meaning of these words.

6. Tell students that people's knowledge of toxics differs, as do their opinions, and that over the next two days the students are going to learn more about toxics. They will interview their family to find out what they know and think about toxics.

7. Hand out the survey forms for students to gather responses at home.

Day Two

8. Using the "Toxics Survey Results" chart you have prepared, compile results of the survey for discussion (see Discussion Questions).

Discussion Questions:

Are most people concerned or not concerned about toxics?

All of the items in question three, except salt and baking soda, contain toxic ingredients. How knowledgeable were the people we surveyed about this? Do their answers to this question agree or conflict with their answer to question six?

What does toxic mean?

What are the risks or benefits of using toxic substances?

What things did most of the people we surveyed agree on?

What else did we learn?

Was there anything that surprised you?

What does opinion mean?

What is the difference between fact and opinion?

What would you like to learn about toxics?

What choices can we make that are more beneficial to the environment and therefore to all of us?

Resource:

The Toxics Lesson Plan, Home Survey and Follow-Up Activity is adapted from *Toxics: Taking Charge.* (Comnes, L; Sly, C., 1989.) This instructional unit for grades 4-6 is available from the Alameda County Office of Education, 313 W. Winton Avenue, Hayward, CA 94544-1198.

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CONTINUATION PAGE—GRADES 4-6

6. Which statement best describes your home?

_____ There are no toxics in my home.

_____ There are some toxics in my home.

_____ I do not know if there are toxics in my home.

7. Would you want to be told if something you are about to buy might be toxic?

_____ Yes

_____ No

_____ Sometimes

For Adults

8. Do you think that people who work where there are toxics should be told this when they are hired?

_____ Yes

_____ No

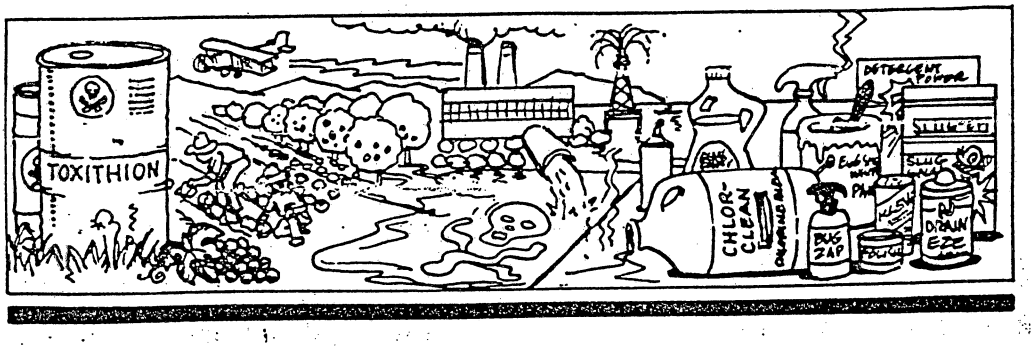
_____ Sometimes

9. Do you think individuals should decide whether to buy and use toxics, or do you think the government should make it illegal to sell toxics?

_____ Individuals should decide.

_____ Government should make it illegal.

_____ I don't know.



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HOME TOXICS SURVEY—GRADES K-6

Name: _____

1. What is your age?_____ Are you male or female?_____

2. What do you think of when you hear the word toxic? (See the explanation at the bottom of page if you are unsure of what the word "toxic" means.)*

3. Which of the following do you use? Which of the following do you consider toxic?*

The *laundry detergent* your parents use to wash clothes.

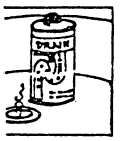
_____ Use _____ Consider Toxic

The *cleanser* your parents use to clean the sink and bathtub.

_____ Use _____ Consider Toxic

The *furniture polish* your parents use to clean and shine furniture.

_____ Use _____ Consider Toxic



The *drain cleaner* your parents pour into sink and bathtub drains.

_____ Use _____ Consider Toxic

The *glass cleaner* your parents use to clean windows and mirrors.

_____ Use _____ Consider Toxic

The *baking soda* your parents use in cooking.

_____ Use _____ Consider Toxic

The *air freshener* your parents use to make the air in your house smell fresh.

_____ Use _____ Consider Toxic

The *ant spray* your parents use to kill ants in and around the house.

_____ Use _____ Consider Toxic

The *hair spray* some family members use to keep their hair in place.

_____ Use _____ Consider Toxic

The *salt* you use to flavor food.

_____ Use _____ Consider Toxic

When do you think it is okay to use something that is toxic?

What room in your home do you think contains the most toxics?

_____

*toxic is any substance that is capable of harming a person if ingested, inhaled, or absorbed through any body surface.

NOWHERE IS AWAY

Goals:
Students will learn what each can do to help solve the problem of too much solid waste.

School Subject:
Social Studies, Mathematics.

Grades:
3rd - 8th

Time:
1 - 2 class periods.

Materials:
- 4 1/2 pounds (2 kilograms) of trash
- Pictures and articles about the solid waste problem

PROCEDURE

1. Bring to class a 4 1/2 pound bag of garbage, or bring in a school garbage can.

2. Emphasize that, on the average, each person in the United States discards about 4 1/2 pounds of waste a day.

3. Using these figures, how many tons of garbage would this class generate in a year? To gain a clearer understanding of the magnitude of a ton, have students add the weights of class members until a ton is reached.

4. Ask: Where does all this waste go? What problems does it create?

5. Show pictures of landfills. Identify local landfills. Tell students that, nationally, most waste goes into 15,000 landfills occupying 467,000 acres. (One acre is about 1.5 times the size of a football field.) Calculate: How many football fields are covered with trash? Emphasize that at the increasing rate at which we are throwing away trash, we need approximately 500 new dumping locations every year. Other problems associated with this growing mountain of trash are:

   - finding sites for landfills is becoming increasingly difficult.
   - runoff and leachate from landfills pollute surface and groundwater.
   - disposing of waste is very expensive (about $4 billion a year is paid by Americans to dispose of trash).

6. Ask: What can you and I do to help solve this problem? Brainstorm possible solutions. Emphasize that one important solution is to generate less waste. Discuss what kinds of waste students generate and discuss ways to reduce it.

7. Emphasize that another solution is to recycle. Using articles from the 4 1/2 pound bag of trash, have students suggest which can be recycled, and sort the bag.

Adapted from ***A-WAY WITH WASTE, 1985***

The No Waste Anthology

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Where Is Away?

Chorus:

G G
Where is away? (leader) Where is away (group echoes)

G
Well it's over there (leader) Well it's over there (group echoes)

C C
Where is away? (leader) Where is away? (group echoes)

C C
Yea, it's over there (leader) Yea, it's over there (group echoes)

D7 D7 C# 7 C7
There's no away (leader) There's no away (group echoes)

Ya gotta throw it somewhere (leader) Ya gotta throw it somewhere (group echoes)

F# G
Well, I took a little trip about a thousand miles,

B9 C9
Get away from the garbage piles.

G# A
I went walking out on the beach,

D# 9 D9
But the broken glass cut my feet.

Chorus: **(Replace last line with) Ya gotta put it somewhere**

I went sailing out on the high seas,
To feel the fresh ocean breeze.
Nothing but sky and sea all around.
Then I ran into an oil slick, it really brought me down.

Chorus: **(Replace last line with) Ya gotta dump it somewhere**

I went backpacking in the high Sierra,
Get some of that clean mountain air.
Get away from that old city rat race,
Right then I stepped in someone else's waste.

Chorus: **(Replace last line with) Ya gotta leave it somewhere**

by Mark Nolan

From ***SONGS FOR THE EARTH, BANANA SLUG STRING BAND, 1985***

INCREDIBLE EDIBLE LANDFILL

Goal:
Students will be able to state some of the problems with landfills and waste disposal.

School Subject:
Social Studies.

Grades:
6th - 12th

Time:
1 class period (one evening of preparation)

Materials:
- Plastic mixing bowl
- 3 different flavors of jello
- Pistachio pie filling
- Chocolate pudding
- Butterscotch pudding
- Pineapple ice cream topping (chunky)
- Creme de menthe ice cream topping (syrup)
- Licorice swizzles
- Root beer barrel candy
- Jelly/nougat candy
- Iced blue lozenges

Optional:

- Plastic cars, insects, furniture, bottles, etc.
- Jar of water
- Vegetable oil
- Pieces of rubber
- Nails
- Dirt or Gravel
- Vinegar

PREPARATION

1. Using the plastic container as a mold, pour in a layer of jello and allow it to set. Remember the first layer poured will be the top of the landfill, but will have the rest of the layers on top of it in the bowl.

2. Add root beer barrels, licorice swizzles, or any other materials to the layer when it is partially gelled.

3. Pour successive layers and add barrels, etc. Allow mold to set.

PROCEDURE

1. Tell students: After studying some of the issues involved in chemical waste in the United States today, it should be interesting to see what kinds of decisions we can make regarding disposal and treatment. Here is a model of a chemical landfill. **Ask:** Can you identify the liner? Point out the leachate seeping out.

2. Challenge the students to eliminate the "waste" before the end of the period. Remove the liner so that the students can inspect the contents. (Explain that all materials are edible and list ingredients to the class.) Tell students: Our edible landfill will represent all the chemical waste in the United States today. Proper treatment of the waste will be represented by consumption of the jello mold. If each of us take an equal share of the jello mold and consume it, there will be none left at the end of the period. Whatever material remains will continue to be a problem for future generations.

3. Consume the "waste".

Alternative 1
The instructor can use different colors of jello and place toy cars, plastic insects, bottles, and candies such as gummy bears etc., into the layered jello. This is a more accurate graphic display of a landfill. The students would not, of course, consume such an inedible presentation.

Alternative 2
Another option is to use a jar of water, and add to it 2 oz. vegetable oil, 2 oz. vinegar, pieces of rubber, several iron nails, a handful of dirt or gravel and food coloring. Explain to the students that this jar represents various hazardous substances which may be present in a hazardous waste dump. Ask: How can this water be cleaned up? (Pieces of rubber could be pulled out with tweezers; nails could be removed with a magnet; dirt or gravel could be filtered out; oil could be soaked up with paper towel).

Here are some examples of applications for real life, using the model:

Model	***Real World***
• Incredible Edible Landfill	• chemical waste
• mold	• liner
• root beer barrels	• barrels of toxic waste
• jello	• chemical sludge
• iced blue lozenges	• aromatic, organic wastes
• liquids formed	• leachate
• eating the jello	• proper treatment
• discarding the jello	• illegal treatment
• extra credit for eating	• incentive

Although the Incredible Edible Landfill is not aesthetic or appetizing, neither is the problem of chemical waste!

Adapted from ***THE INCREDIBLE EDIBLE CHEMICAL LANDFILL*** by Rich Wagner, Wissahickon Senior High School, Ambler, PA and from ***CALIFORNIA CLASS PROJECT, 1984***

Week 3

Objectives and Overview

Students will:

Identify causes of air and water pollution.
Investigate means of cleaning up many forms of water pollution, including oil spills.
Understand the fallacy when we say to throw something "away." Nowhere is away.

Day 1

Language arts: 90 minutes
Read aloud Wump *World* by Bill Peet (3.1) and *Larue and the Brown Sky* - a book written in verse about air pollution.

Science: 30 minutes
Something's in the Air (3.2) - Students see visible pollutants and learn to explain about invisible pollutants. Assessment by identifying pollutants in a scene.

Science: One or two 45-minute periods
What are the Alternatives? (3.3) - Students investigate alternatives to the commercially available cleaners.

Art, social studies: 45 minutes
Going Green (3.4) - Students create advertisements for products that are safer for the environment.

Language arts:
Worksheet on *"Ing" words* (3.5) - Basic skills

Assessment: 15 minutes
Air Pollution Crossword Puzzle (3.6)

Music:
Brown Air (3.7) - Song by Mike levy of the Banana Slug String Band

Day 2:

Science, language arts, social studies: 45 minutes
Fred the Fish (3.8) - This is an interdisciplinary water pollution activity. The cartoons at the end can be blown up and used as part of the script reading. A suggested follow-up activity is to have the students write a story about Fred's life. Additionally, the students always enjoy writing a class eulogy to Fred and conducting a burial. You can sing "Taps."

Homework-
Tell students that tomorrow they will try to clean up Fred's river. They can bring items from home to help with the clean up if they would like.
Language arts, art: two 45-minute periods
Read aloud *A River Ran Wild* by Lynne Cherry. Take time to show all of the border illustrations in this magnificent book that tells the history of a river. When finished, create a class mural, with water colors at least for the river itself, showing the different stages of this river.

Social studies: 90 minutes
Guilty or Innocent? (3.9) - This activity can be used as an assessment for understanding water pollution on an individual basis. Another option is to have groups assume the role of the jury for one of the characters. The group then works together to determine if the character is guilty or innocent and will write up their explanation and report back to the class.

Music:
The River by Steve Van Zandt on the Hot Mud tape (See resource list for ordering information.)

Physical education: 15 minutes, may be repeated
Out of Balance (3.10) - Students physically demonstrate how a system gets out of balance through a ball throwing activity.

Day 3:

Science: 60 minutes
After hearing the book *The Magic School Bus at the Waterworks* by Joanna Cole, students will do the activity *River Clean-up* (3.11). Using the polluted water from *Fred the Fish*, students will try to clean up the water by devising their own filtration system.

Social Studies: four 45-minute periods to prepare and debate
Assign students to the various debates. The activity *Tough Choices* (3.12) has 4 issues to debate. *Are You Part of the Problem* (3.13) has five issues and ideas on guiding the discussion. *A Heated Controversy* (3.14) presents two sides of global warming. Students will prepare and then have actual debates throughout the week.

Language arts, science, art: 90 minutes
Activity *Away with Waste* (3.15). Read the poem *Away on the Bay* (3.16). This can be done as a read aloud as suggested in the lesson plan. Alternatively, the poem verses could be divided between groups of 3-4 students with the entire class reading the first and last verses. Each group could then illustrate their verse, glue the words to the illustration and make a class book of the poem.

Language arts:
Choose the Best Title Worksheet (3.17) - Basic skills

Read aloud: 25 minutes
Cry Me a River by Rodney McRae - This is a moving story of water's journey from mountain snow to the sea.

Physical Education: 45 minutes
Deadly Links (3.18) from Project WILD. Instead of using the animals listed, use river animals instead. For example, the grasshoppers can be flies, the shrews can be frogs, and the hawks will still be hawks.

Math and homework: 45 minutes
Learning About Wastewater (3.19) - Students will estimate mathematically how much waste water each of them produces in a day. Complete *What Makes Wastewater* (3.19) exercise as homework tonight. Complete the rest of the activity, except save the *Family Activity Sheet*, tomorrow. Save the *Family Activity Sheet* as Friday's assessment.

Day 4:

Language arts, science, social studies, art: Four 45-minute periods
Students each write a newspaper article for a class paper on keeping their habitat healthy. When articles have been written and edited, students could work on adds, comics, weather and other features. Duplicate. Have the students take the completed newspaper home to their families.

Read aloud: 20 minutes
Tale of Antarctica by Ulco Glimmerveen tells the story of penguins in Antarctica as they encounter trash and oil spills caused by humans.

Poetry: 10 minutes
Read *Little Jack Horner* (3.20) - a new, environmental version

Art: 60 minutes
Draw a river or other marine scene with oil pastels. Then paint over parts of it with India Ink to simulate an oil spill.

Science:
Students will attempt to clean up an "oil" spill. *Alaska Oil Spill* (3.21) gives ideas and serves as background information. The activity *An Oil Spill in the Classroom* (3.22) is simpler. Following, or concurrently, in *Critter Clean-up* (3.23), the students will try to clean up simulated animals (fur and feathers). **Note**: Use **syrup** instead of motor oil. It is highly effective and you do not need to deal with a hazardous waste.

Physical education: three 40-minute periods
The Alaska Oil Spill Game (3.24) - Students will participate in an active, simulated oil spill g

Day 5:

Language arts, science, social studies, art:
Work on publication of class newspaper.

Read aloud:
Read *The Lorax* by Dr. Seuss. Lead a discussion including the following questions:

- Who do you think the Once-ler represents?
- Who do you think the Lorax represents?
- What is a thneed? Name some real thneeds.
- The Lorax says he, "speaks for the trees, for the trees have no tongues." If you were a Truffula Tree, what might you say?
- The super-ax-hacker represents technology. Is technology always bad? Is technology always good?
- What does, "UNLESS" mean?

Drama:
Circles of the Earth (3.25) - This is a culminating activity that is a readers' theater overview of the Earth done in groups

Assessment - *Family Activity Sheet* (3.26)

Post Assessment - (3.27) - Compare movement in student attitudes from the pre-assessment survey to the post-assessment based on the answers representing desired environmental attitudes as shown in the *Post-assessment Key* (3.27). For example, if in the Pre-assessment a student had the least desirable answer and in the post-assessment s/he has moved to the middle or the most desired answer, then growth has been shown.

Grammar Skill Sheet Solutions (3.28)

Assessment of *The Wump World* 3.1

by Bill Peet

Plot summary: The Wumps' world is invaded by the Pollutians who have destroyed their own planet and move onto the Wumps'. The Wumps go into hiding underground to avoid the Pollutians' belching machines that are ruining the Wumps' homeland. Finally the Pollutians decide to leave since this world has gone sour. The Wumps note the silence and go up to discover their world deserted, but changed. There is no signs of trees. They wandered through the ruins and finally find a grassy meadow, a sign of hope. They realize that slowly the world will begin to clean but it will never be the same again.

Environmental Concepts:

Pollution ruins our environment.
People living in modern cities are able to modify their environment.
People's relationship to the environment has been altered due to urbanization.
Societies develop different ways of conserving or destroying natural resources depending on the aims of the particular culture.
People change environments through housing and pollution.
Once ruined the environment will never be the same as it had been before.
People can hide from the pollution or they can make a stand against it.

Assessment :

A. Verbal: Lead a discussion using some of the following questions to assess understanding of the plot.

Is this a fiction or an non-fiction book?
Where did the Pollutians come from?
What did the Wumps do when the Pollutians arrived?
Why did the Pollutians leave?
What did the Wumps do when they heard the silence?

Inference:

We agreed this is a fiction book. Can it symbolize anything real?
Who might be the Pollutians in our world?
Might you sometimes be a Pollutian? How?
Are you sometimes like the Wumps? How?

B. Written: Write a paper that begins in one of the following ways:

1. "When I see Pollutians in my neighborhood, instead of hiding underground like the Wumps I can ..." to look for students' sense of responsibility and control.
2. "Sometimes I've been a Pollution. In the future I won't ... anymore." to check for the students behavioral change.
3. "A real life Pollutian I know about is..." to be certain the student s understand the symbolism in the book.

C. Drawings:

Give students a piece of drawing paper. Have them fold it in half. On one side draw a picture of their neighborhood. On the second side draw what it would look like if the pollutians came to live.

ACTIVITY: SOMETHING'S IN THE AIR

Observe a burning candle; then identify some common sources of air pollution.

OBJECTIVES:
Name several sources of air pollution. Explain that burning can release visible and invisible air pollutants.

GRADE LEVEL:
Primary

MATERIALS:
- *Copies of page 15*
- *Candle and match*
- *White or clear Pyrex cover or other heat-resistant glass*
- *Crayons or markers*

SUBJECT:
Science

By taking part in this activity, your kids can learn how burning contributes to air pollution and can identify some common sources of air pollution. Begin by having the kids take a deep breath. Ask them to name the "stuff" they're breathing. (Air) Then ask the kids to tell you everything they know about air. During your discussion, you may want to ask questions about what kinds of things need air to live; whether you can see, taste or feel air; and so on.

Next ask if anyone knows what people mean when they say that air is polluted. Explain that polluted air contains too much of something that can hurt people and other living things. Most air pollution is caused by people burning things. For example, when wood burns in a fireplace, gases and small particles that can pollute the air are released.

Ask the kids to give some examples of air pollution that they've seen. Then ask if they think air pollution can ever be invisible. Discuss their answers, and then tell the kids that they'll be watching a demonstration that shows you can't always see air pollution. Place a candle where everyone can see it and light it. (Blow out the match away from the candle so the smoke doesn't distract the kids.) Ask the kids if they can see any pollution coming from the burning flame. (No) Next, lower the glass cover over the candle until it touches the flame. Hold the glass in the flame for a few seconds. Then take away the glass but leave the candle burning.

Have the kids look at the glass and describe what they see. (Soot collected on the glass.) Explain that as the candle burned, it released gases and very small particles of the burned wax into the air. But the particles weren't visible until they collected on the glass.

Now blow out the candle to show how smoke is produced when the flame goes out. (When you blow out the flame, the temperature of the burning wax drops. At this lower temperature, the burning is not as complete as it was at the higher temperature. The partially burned bits of wax form smoke.)

Next pass out a copy of page 15 to each person and have the kids put an "X" on the things that they think cause air pollution. (If you're working with very young kids, you may want to do the page as a group.) You can also have the kids list the things that cause air pollution that you can see plus things that produce air pollution you might not be able to see. (You would probably see smoke coming from the barbecue, factory and chimney, but you probably wouldn't see it coming from the car, truck, lawn mower or jet.)

After the kids have finished, go over the page using the answers below. Be sure to explain that as car, truck and jet engines work, they burn fuel and release pollutants into the air, but you usually can't see the pollutants that they release. Point out that all air pollutants, whether you can see them or not, can affect people's health. For example, air pollution can make people's eyes and throats burn, make it harder for them to breathe, and even give some people heart and lung disease. Polluted air can also make plants grow more slowly.

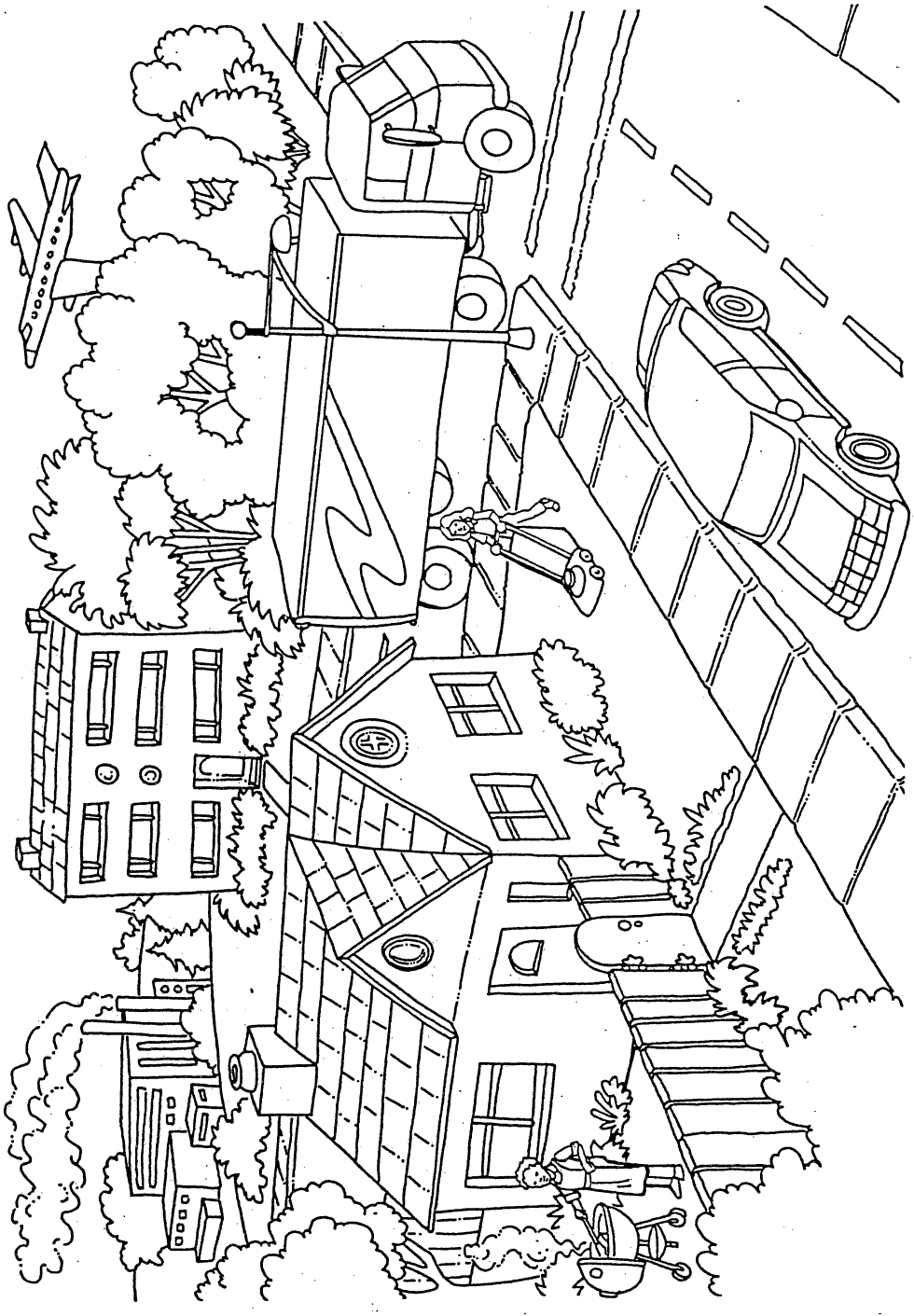
To finish up, have the kids think of some ways that people could help reduce air pollution. (Drive more fuel-efficient cars, operate dishwasher and clothes washer and dryer after bedtime and so on.) Also see "Choices and Challenges" on page 22 for more ideas on how kids can help reduce pollution.

ANSWERS: Car, jet, truck, factory, barbecue, lawn mower, chimney.

Where's the fresh air?

During a smog alert, it's a good idea to stay indoors, right? That depends. Serious air pollution problems can exist inside buildings- a phenomenon called "sick building syndrome." Pollutants come from a variety of sources: treated wood; particle board; new carpet; copy machines; cleaning fluids. They tend to build up in energy-efficient, relatively airtight buildings. Pollutants such as formaldehyde, nitrogen oxides, carbon monoxide and radon are some common "sick building" troublemakers. They build up and interact with each other to cause health problems ranging from minor irritations to serious diseases like cancer. Cutting down on these sources of pollutants and improving ventilation are the best ways to control indoor air pollution. You can also get help from pollution-fighting plants. Philodendrons and spider plants are a few of the best pollution fighters.

COPYCAT PAGE: *Something's in the Air* 3.2



WHAT ARE THE ALTERNATIVES? AND SELLING A SAFER ALTERNATIVE

TOXICS FOLLOW-UP ACTIVITY—GRADES 4-6

SUMMARY OF ACTIVITY:

Students assess positive and negative consequences of using a familiar product that is toxic. They will then test a safe alternative to a toxic cleaning product and invent an ad campaign to sell the safer alternative.

Time: Two 45-minute periods plus time between for research and analysis.

Setting: Classroom

Materials:

- Copycat page, one per group of four.
- "Hazards of Household Products" sheet.
- For glass cleaner of vinegar and water; one tablespoon of white vinegar, one quart water, container for mixing the solution, and one sponge and squeegee for each group of four students.
- Materials needed to test any other non-toxic cleaning alternative.
- Drawing paper and colored pens or crayons.

BACKGROUND INFORMATION:

A toxic is any substance that is capable of harming a person if it is ingested, inhaled, or absorbed through any body surface. Every chemical can be toxic if too much of it is present, however. For example, salt can be toxic if taken is such a large quantity (e.g.: many cupsful) that it is harmful. Many substances, such as oranges, are virtually nontoxic, while other substances, such as the botulinus toxin (causing botulism), are so poisonous that a single taste can be deadly.

To help clarify the term toxic for regulatory purposes, Congress defined toxic substances in the Toxic Substances Control Act (TSCA).

According to this act, a toxic substance is a chemical or mixture of chemicals whose manufacture, processing, distribution, use, or disposal may present an "unreasonable risk" to the health of a person and the environment.

Risk is measured in two ways: by the inherent toxicity of the chemical (for example, oranges versus botulinus) and by the amount of exposure. Determining the severity of risk means taking these two risk factors and balancing them against the potential benefit to society. In this way, decision makers determine whether the substance in question poses an unreasonable risk of injury. Obviously, the process is complicated, and the final assessment relies on a value judgment; what is considered a reasonable or unreasonable risk depends on who is making the assessment.

Most controversial issues are controversial because there is no easy answer. People have different ideas about what is right and wrong and what is good and bad. The more deeply people care about an issue for health, emotional, or monetary reasons, the more controversial the issue is likely to become. Toxic substances can be extremely controversial because they involve all three concerns—health, emotions, and financial investments.

PREPARATION AND LEAD-UP:

Make copies of "Hazards of Some Household Products" sheet and the copycat page (attached) for each student group.

ACTIVITY FOR GRADES K-3:

Refer to step two under "Activity for Grades 4-6." Have a discussion about the pluses and minuses of a certain toxic product. Then talk with the students about possible safe alternatives.

ACTIVITY FOR GRADES 4-6:

Day One

1. Ask students what the words *plus, minus, positive consequences,* and *negative consequences* mean. Tell them that in this activity they will look in-depth at a particular product to find out positive and negative consequences (pluses and minuses) of using the product. Students will then discuss nontoxic alternatives to the product and analyze the pluses and minuses of these. Finally, students will make a recommendation to the class about using the toxic

Going Green

Create advertisements for products that are better for the environment than existing products.

Objectives:
Name some pollution problems associated with various products. Explain how consumers can cut down on environmental problems by being careful about what they buy.

Ages:
Intermediate and Advanced

Materials:
- ***chalkboard or easel paper***
- ***slips of paper***
- ***research materials (optional)***

Subjects:
Social Studies and Art

All kinds of products are "going green" these days. Companies are finding out that being sensitive to environmental concerns is a selling point, and many of them are changing their products and marketing to keep up with the trend.

By creating ads for "green products," your kids can learn about some of the ways companies are responding to the public's growing concern about pollution and other environmental problems. They'll also get a feeling for the ways their own consumer choices affect the environment.

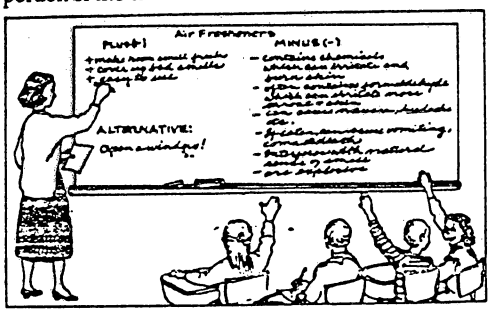
Before you begin, write each type of product listed on page 78 on a separate slip of paper. Also copy the questions under "Product Particulars" on a chalkboard or sheet of easel paper where everyone can see them. Then start the activity by dividing the group into teams of four or five and having each team pick one of the slips. Give the teams time to brainstorm and, if necessary, research some ways their product might cause pollution. Tell them to think about all aspects of their product, using the questions under "Product Particulars" as general guidelines. Also have them think of other aspects of their product that might contribute to pollution.

Next tell the kids that each team will be responsible for coming up with an ad campaign that focuses on a "new, improved" version of each product. To do this, the kids should think of ways that their products could be made less environmentally damaging. Then they should incorporate their ideas into an ad or series of ads that they'll present to the rest of the group. For example, the kids can draw colorful posters, write a jingle, or act out a TV or radio commercial.

After each team's presentation, discuss some of the pros and cons of the "improved" products. Also discuss whether these products will really be better for the environment or will simply cause other pollution problems. For example, the "milk group" might have advertised their new

product.

2. To demonstrate, as a class go through the procedure using air fresheners as an example. Most air fresheners work by desensitizing your sense of smell a little, coating your nasal passage with an oily film, or masking the unpleasant odor with another odor. Students will probably now know some of the minuses of air fresheners; you can provide them with the information to fill in that portion of the chart.



3. Instruct students to divide into groups of four and to fill out the copycat page choosing one item from the "Hazards of Some Household Products" sheet. Tell students that each group will report to the class its recommendation, whether and how the toxic product should be used, and reasons for the recommendation. Remind students that you expect all four members of each group to participate.

4. Have each group report to the class its recommendation for use of the product. Groups should then explain their reasoning.

Discussion Questions:

Were there things all members of your group did not agree on?

How did you come up with a recommendation that you all agreed on? Was it difficult to do?

How realistic do you think our recommendations concerning these products are? Why?

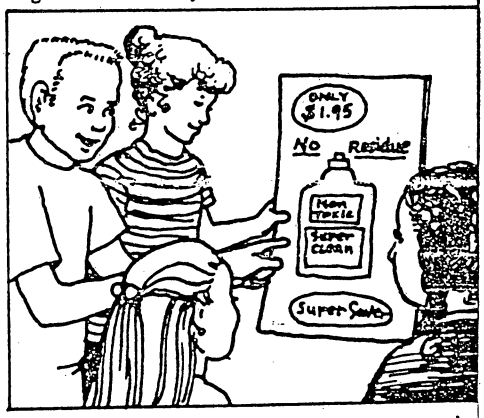
Day Two

1. Tell students that they are going to test a non-toxic alternative to a product. After testing the alternative, they will then invent an advertisement that will pursuade people to use the product.

2. Divide students into groups of four. Have them mix the ingredients of the safe window cleaning alternative and then test it on a window or formica table surface.

3. Ask students how well the alternative worked. What are the pluses and minuses of using the alternative? What might be selling points for the alternative?

4. Challenge each group of four students to invent an advertisement that would persuade people to use the alternative. Groups may want to develop a television advertisement that they act out or a magazine ad that they draw.



5. Have each group present its advertisement to the entire class. Afterward, help students talk about how well the advertisements worked and what tactics were used to persuade potential customers (see discussion questions).

Discussion Questions:

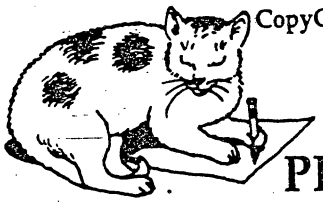
What tactics did you use to persuade your potentia customers?

Did you exaggerate, or did you use only the facts?

Did you leave out any information?

Did you include any minuses in your ad? If not, why not?

Why do you think real life ad makers avoid the minuses?



CopyCat Page

Earth Day 1990

PRODUCTS: PRO'S AND CON'S

Names: _____

_____

_____

_____

Product: _____

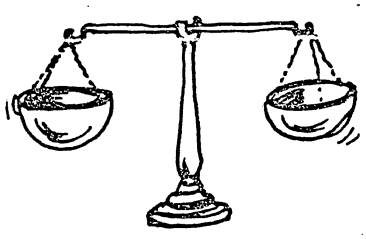
Plus (+) Minus(-)

Alternative: _____

Plus (+) Minus(-)

Alternative: _____

Plus (+) Minus(-)



Recommendation:

product as being better for the environment because the plastic jug it comes in is degradable. But many scientists are skeptical about how the word "degradable" is used. (See "Beware of Buzzwords" below for more information.)

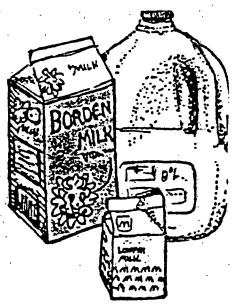
After all the teams have made their presentations, tell the kids that some companies really are developing products that are less harmful to the environment. For example, one company sells concentrated fabric softener in small cardboard cartons. Consumers can buy the cartons, pour the concentrate into the empty plastic fabric softener jug, and add water. By purchasing the cardboard fabric softener refills instead of another plastic jug, consumers can cut down on plastic waste.

Also point out to the kids that, while some companies are making an effort to have less of an environmental impact, others are taking advantage of the "popularity" of environmental concern by making misleading or inaccurate statements about their products. (See "Beware of Buzzwords.")

To wrap up your discussion, ask the kids if they can think of ways individuals can avoid or cut down on the pollution problems associated with many consumer products. Use the information under "Be a Supermarket Activist" in the margin to reinforce their ideas.

As a follow-up, take the kids on a field trip to a grocery store to look for "green" products, as well as products that may have some pollution problems but that could be made less harmful to the environment. Also look for products that might have misleading (or even inaccurate) claims. For example, certain products that are available in spray cans, such as some hair sprays, have phrases such as "environmentally safe" printed on the can. It's not clear exactly what this means, but it could be a reference to the fact that the product contains no ozone-damaging CFCs. (In 1978, the use of CFCs was banned in most spray products in the U.S.) But what kinds of chemicals are used in the product *instead* of CFCs, and what effects might these chemicals have? What about the disposal of the empty can? Is it environmentally safe in a landfill?

PRODUCTS
- apples
- paper towels
- sink cleanser
- plastic trash bags
- laundry detergent
- shampoo
- microwave meal
- soda
- milk
- spray deodorant



PRODUCT PARTICULARS
- What is it made of?
- Where do the ingredients come from?
- What processes are used to get or make the ingredients?
- How is it made?
- How is it packaged?
- Is it reusable?
- Is it disposable?
- Is it recyclable?
- Is it safe and/or healthy?

BEWARE OF BUZZWORDS

"Degradable" is a word that's cropping up more and more these days. Something that's degradable can be broken down into smaller components by natural processes.

Given enough time, natural processes will break down anything (although, depending on the substance and the circumstances, it may take hundreds or thousands of years for decomposition to occur). No standard legal definition of the word (that is, one that advertisers must adhere to) has been established, so technically speaking, just about any product can be labeled as degradable—even if it takes years for the product to decompose.

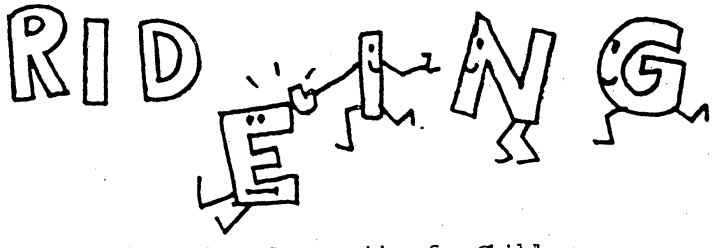
Besides degradable, other advertising "buzzwords" to watch out for include *nontoxic, natural, organic,* and *environment-friendly*. Again, there are no legal guidelines for how these words can be used, so advertisers can—and sometimes do—use them very liberally.

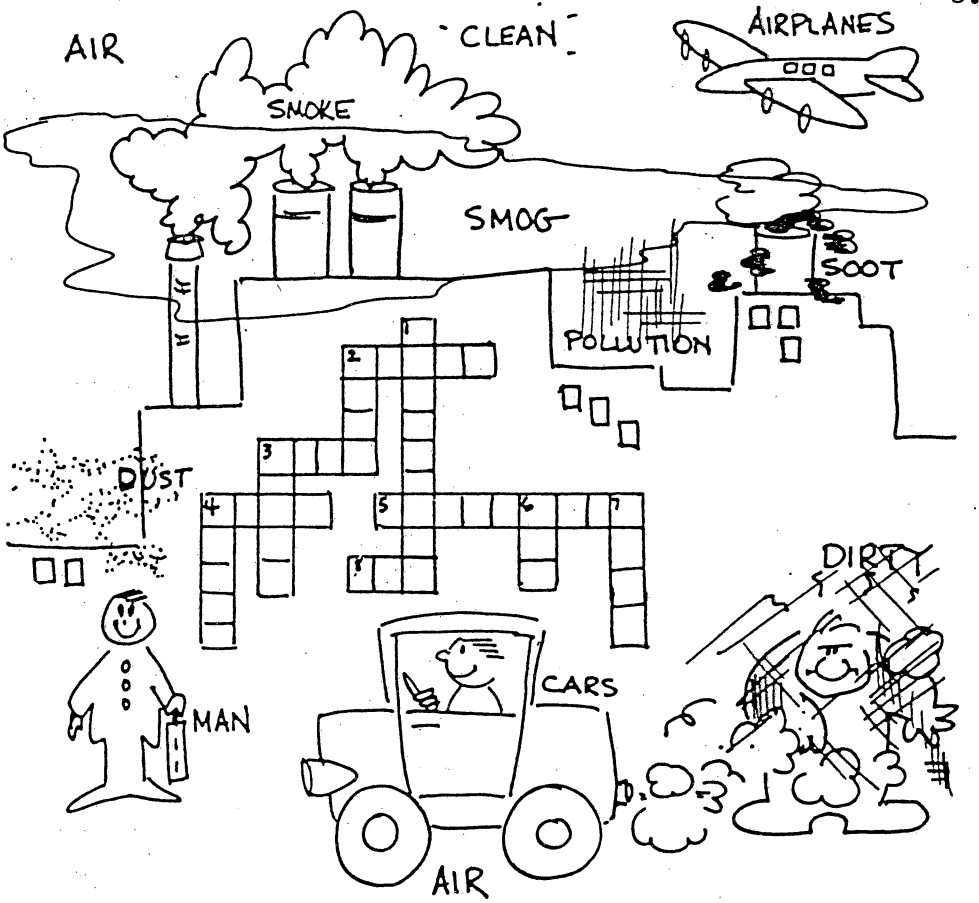
Directions: 3.5
Read the sentences. Add ing to the underlined words and fill in the blanks.

Don't forget to drop the silent e.

Example: come coming

1. Since cars cause air pollution, car pooling is better than drive _____ alone.
2. Letting the faucets drip is waste _____ water.
3. Throwing trash out your car window is cause _____ pollution of the earth.
4. Use _____ paper cups is more wasteful than drinking from cups that can be washed and used many times.
5. Smoke _____ chimneys from factories pollute the air.
6. Smog in the air is damage _____ to plants and animals.
7. Dumping sewage into lakes and rivers is make _____ them polluted.
8. Take _____ old newspapers to a recycling center helps save trees.
9. Oil spilled in the ocean is pollute _____ the water and killing birds and fish.
10. Using too much paper and plastic in package _____ the things we buy causes pollution of the earth.





POLLUTION PUZZLE

Across

2. Smog is fog and _____.
3. Powdered dirt is _____.
4. Exhaust from _____ adds dirt to the air.
5. Exhaust from _____ also adds dirt to the air.
8. Only _____ can help clean up the air.

Down

1. Dirty air is called _____.
2. Ashes are sometimes called _____.
3. Polluted air is _____.
4. Air without pollution is _____.
6. We need _____ to breathe.
7. Smoke mixed with fog is _____.

BROWN AIR

(the song)

Chant:

A7 aug9 A
Brown Air! Brown Air! Yuk!
Brown Air! Brown Air! Yuk!

G A G A
I'm a loose and leafy lettuce plant (a loose and leafy lettuce plant)

G A G A
I love to grow but sometimes I can't (a loose and leafy lettuce plant)

G A G A
You see I live right by the street (a loose and leafy lettuce plant)

G A G A
And car smoke makes me really beat (a loose and leafy lettuce plant)

Chorus:

D E A D E A
Brown Air, Brown Air...It makes you cough and it makes you choke

D E A E E7 E
Good Air, Clean Air...Is air that's clean and free from smoke

D E A D E A
Brown Air, Brown Air...Sometimes you can't even see it

D E A D E A
But Good Air, Clean Air...You know it's safe to breathe it...

(Chant)

I'm a green and growing maple tree (a green and growing maple tree)
And I like rain, but you know it's killing me (a green and growing maple tree)
When it hits me I feel pain (a green and growing maple tree)
Cause air pollution makes acid rain (a green and growing maple tree)

(Chorus/Chant)

I'm a hip and hopin' human being (a hip and hopin' human being)
And I don't like some things I'm seeing (a hip and hopin' human being)
Well dirty air is just no fun (a hip and hopin' human being)

Fred the Fish

3.8

An Interdisciplinary Water Pollution Activity

BY PATRICIA CHILTON-STRINGHAM AND JAN WOLANIN

Materials and Equipment:

The whole class will need:

- Script pages
- A pair of scissors
- 9 large index cards
- A glue stick or some tape
- A light-colored sponge
- A yarn needle
- A small weight (metal nut)
- String
- A wide-mouthed jar or large beaker
- Cold tap water
- A pencil
- 5 small paper cups or baby food jars
- Soil
- Brown sugar ("fertilizer")
- Pancake syrup or molasses ("oil")
- Salt
- Punched paper dots ("litter")
- A medium beaker or glass jar
- Detergent
- Warm tap water
- Red food coloring ("sewage")
- Green food coloring ("toxic waste")

Focus:

Without water, life would be impossible. We use it in many ways—for drinking, bathing, recreation, farming, and manufacturing. We depend on a continuous supply of clean water, yet each time we use it we change it—sometimes by polluting it.

Challenge:

In what ways do we pollute water? How can we clean the water we pollute? How can we prevent water pollution?

Time: One to four 30–45 minute class periods

Procedure:

1. Copy and cut apart the nine roles from the script at the end of this activity, and attach them to the large index cards with tape or glue.

2. Cut a fish shape out of the sponge. Use the yarn needle to thread a string through the bottom of the fish, and then attach the weight so it hangs below the fish.

3. Fill the large glass jar or beaker two-thirds full with cold tap water. Thread another string through the top of the fish, and suspend it in the water by tying it to a pencil positioned across the mouth of the jar. Adjust the length of the string until the fish is suspended midway in the jar of water (see the figure).

4. Number the paper cups or baby food jars 1 through 5, then place soil in cup 1, brown sugar ("fertilizer") in cup 2, pancake syrup ("oil") in cup 3, salt in cup 4, and paper dots ("litter") in cup 5. Pour detergent and warm water into the medium-sized jar, and set out red and green food coloring ("sewage" and "toxic waste").

5. Next, introduce Fred the Fish to the class. Tell them that he has grown up in a protected stream in a nature preserve, but he is about to leave the preserve and journey downstream. The class has been invited to share in his adventure.

6. Distribute the script cards, cups, food coloring, and jar of warm, sudsy water to 17 volunteers. Ask all the students in the class to number their papers from 1 to 9. As the students with script cards read, those with the appropriate ingredients should dump them into Fred's jar on cue. Every student should write down a different descriptive adjective each time

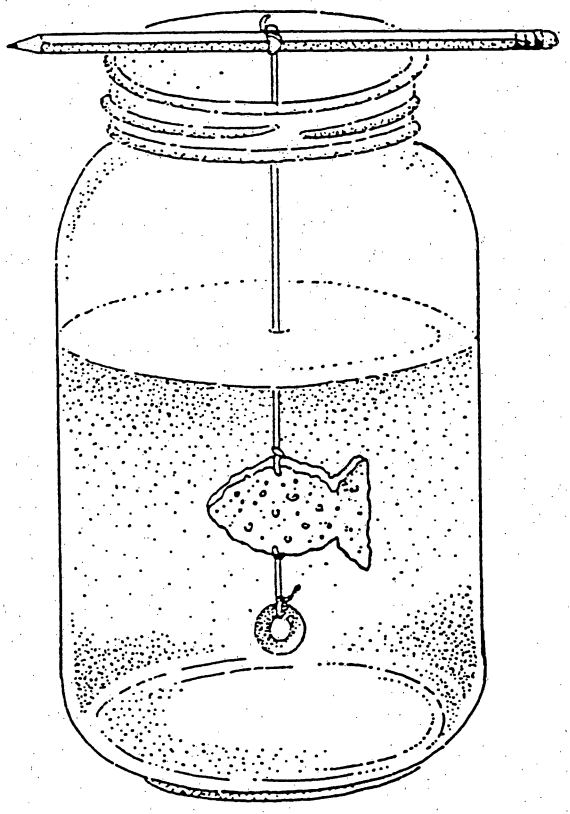
they are asked the question, "How is Fred?"

7. After all the ingredients have been dumped in, lift Fred out of the jar, and discuss the change in his appearance and that of the water. (Someone will probably remark that Fred looks dead.)

8. Ask students to compare their lists of adjectives, and then draw cartoons depicting Fred's adventure. (See the example at the end of this activity.)

9. Do not dump the contents of the large jar down the sink. Instead, pour the contents through a strainer over a large, grassy area where natural filtration can take place. Throw away the paper dots strained from the water.

Q What are some ways to dispose of Fred's polluted water? What are the environmental consequences of each alternative? (Where does water go when it is flushed down the toilet? Poured down the sink?)



Further Challenges:

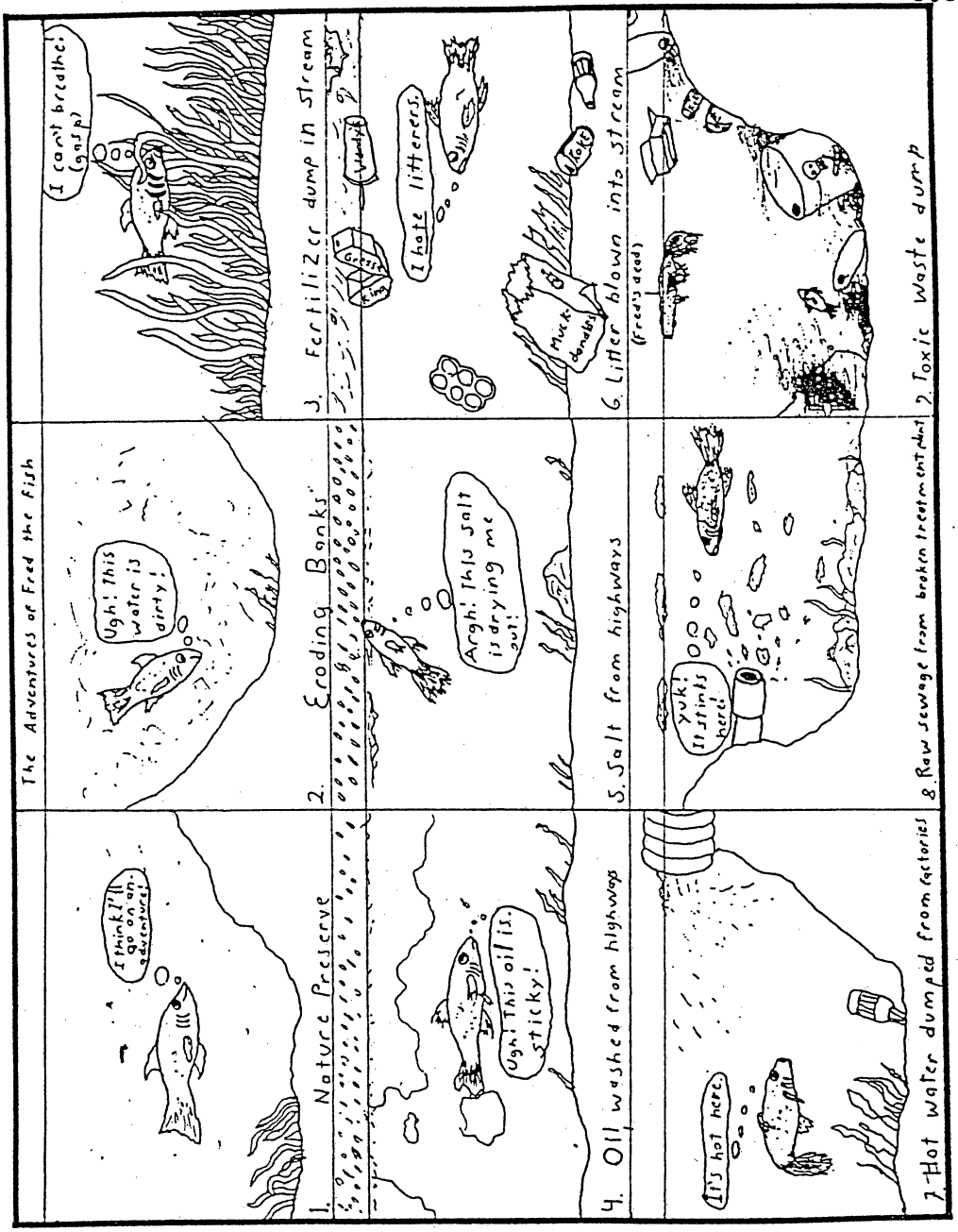
Find out where the wastewater in your home or school goes. Contact your local health department regarding septic systems or visit a wastewater treatment plant in your community.

References:

Chilton, Patricia. (1979). *A fish story.* Kalamazoo Soil Conservation District. Kalamazoo, MI.

The Authors

Patricia A. Chilton-Stringham is an environmental educator in Portage, MI. Janet L. Wolanin teaches science at the St. Francis School in Goshen, KY.


The Adventures of Fred the Fish
I think I'll go on an adventure!
1. Nature Preserve
Ugh! This water is dirty!
2. Eroding Banks
I can't breathe! (gasp)
3. Fertilizer dump in stream
Ugh! This oil is sticky!
4. Oil washed from highways
Argh! This salt is drying me out!
5. Salt from highways
I hate litterers.
6. Litter blown into stream
It's hot here.
7. Hot water dumped from factories
Yuk! It stinks here!
8. Raw sewage from broken treatment plant
9. Toxic waste dump

Script Page

1. Imagine a clean river as it meanders through a protected wilderness area. In this river lives Fred the Fish. HOW IS FRED? Fred has lived in this stretch of the river all his life. But now he is going on an adventure and travel downstream.

2. Fred swims into farm country. He passes a freshly plowed riverbank. It begins to rain and some soil erodes into the river. (Dump soil into Fred's jar.) HOW IS FRED?

3. Fred nears a suburban housing development. Some fertilizer from the farms and the lawns washed into the river awhile back. (Place brown sugar in Fred's jar.) The fertilizer made the plants in the river grow very fast and thick. Eventually the river couldn't furnish them with all the nutrients they needed, and so they died and are starting to decay. Their decomposition is using up some of Fred's oxygen. HOW IS FRED?

4. Fred swims under a highway bridge. Some cars traveling across it are leaking oil. The rain is washing the oil into the river below. (Pour pancake syrup into Fred's jar.) HOW IS FRED?

5. During a recent cold spell, ice formed on the bridge. County trucks spread salt on the road to prevent accidents. The rain is now washing salty slush into the river. (Put salt in Fred's jar.) HOW IS FRED?

6. Fred swims past the city park. Some picnickers didn't throw their trash into the garbage can. The wind is blowing it into the river. (Sprinkle paper dots into Fred's jar.) HOW IS FRED?

7. Several factories are located downriver from the city. Although regulations limit the amount of pollution the factories are allowed to dump into the river, the factory owners don't always abide by them. (Pour warm, soapy water into Fred's jar.) HOW IS FRED?

8. The city's wastewater treatment plant is also located along this stretch of the river. The pollution regulations aren't as strict as they should be. Also a section of the plant has broken down. (Squirt two drops of red food coloring into Fred's jar.) HOW IS FRED?

9. Finally, Fred swims past a hazardous waste dump located on the bank next to the river. Rusty barrels of toxic chemicals are leaking. The rain is washing these poisons into the river. (For each leaking barrel, squeeze one drop of green food coloring into Fred's jar.) HOW IS FRED?

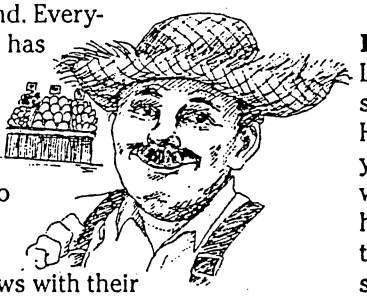
3.9

COPYCAT PAGE: *Guilty or Innocent? - B*

Two days ago, the Granville water inspector discovered pollutants in Davies Creek, the creek that runs through the middle of town. A short time later she found contaminants in several private wells. Using the hints on page 18, can you figure out which of these Granville residents might have contributed to the problem?

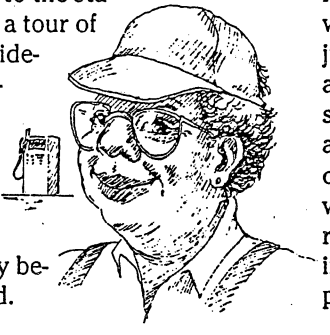
Joe Ramos

Joe Ramos's farm is the one of the biggest in the Granville area. In the summer, people come from all over to buy fruits and vegetables from Joe's stand. Everyone knows that Joe has some of the most beautiful produce around—almost always free of insect damage. Kids like to come to the stand with their parents and watch Joe's cows with their calves in the field next to Davies Creek.



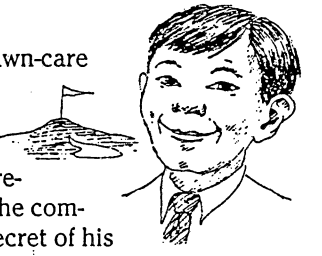
Martha Stone

Martha Stone's small gas station near the center of town has become a landmark in Granville. Every day Martha is there selling gas, candy and ice-cold sodas. Everyone who goes into the station is sure to get an earful of stories about what life in Granville used to be like. First-time visitors to the station almost always get a tour of it, starting where the sidewalk covers the underground storage tanks. Here Martha proudly shows people where she carved her initials and the year "1953" in the wet cement the day before the station opened.



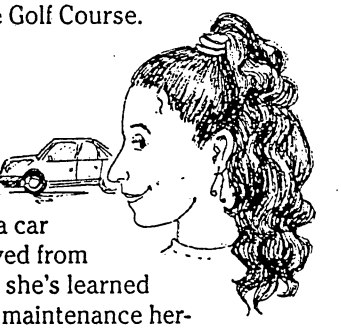
Michi Akizawa

When he started his lawn-care company five years ago, Michi Akizawa had no idea it would be so successful. In a recent interview about the company, Michi said the secret of his success was his special training program, which teaches workers the best ways to use fertilizers and weed killers. He's proudest of the thick, green grass his company tends at the Granville Golf Course.



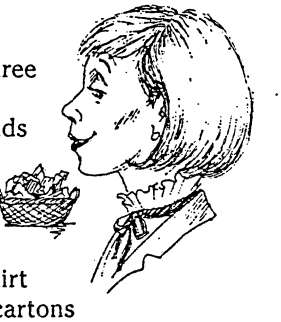
Leila Khalil

Leila Khalil is a senior at Granville High School. A year ago she bought a car with money she'd saved from her parttime job, and she's learned to do most of the car maintenance herself. She changes her own oil and adds wiper fluid and antifreeze when necessary. After Leila works on her car, she cleans up, pouring her used motor oil down the storm drain and hosing down her parent's driveway.



Sabina Karowski

Sabina Karowski and her three kids just moved into an old house near the park. The kids found a shed covered with vines and full of junk. They want to use it as a clubhouse, so they swept out a thick crust of dirt and carried away thirteen cartons of old cans and bottles from paint thinners, wood preservatives, paint strippers and rust removers. Sabina poured any liquid remaining in the containers down the toilet before putting the junk out for the garbage collector.



Let's Clean Up Our Act: POLLUTION SOLUTIONS
Produced by the National Wildlife Federation for National Wildlife Week 1994

ACTIVITY: GUILTY OR INNOCENT?

3.9

Use clues to figure out whether five people in a town are guilty of polluting water.

OBJECTIVES:
Describe several ways people pollute water.
Explain some ways people can help prevent water pollution.

GRADE LEVELS:
Intermediate and Advanced

MATERIALS:
- *Copies of copycat pages 18 and 19*
- *Chalkboard or easel*
- *Paper*

SUBJECTS:
Science
Language Arts

It's easy to understand that a crippled tanker leaking millions of gallons of crude oil into the ocean is polluting the water. But recognizing other forms of water pollution can be more difficult. In this activity, your group will discover some of the not-so-obvious ways people pollute water every day.

Begin the activity by asking students to name ways water gets polluted. Write their ideas on a chalkboard or piece of easel paper, and tell the kids they'll be adding to this list of pollution sources later.

Next, explain the terms groundwater and surface water, using the information on page 16. Pass out copies of the hints on page 18, and explain that all the facts relate to water pollution. Have the class read the page, and explain any facts they don't understand.

Next, pass out copies of the clues on page 19. Ask the class to read the description of each person and then use the hints on page 18 to decide whether the person is guilty or innocent of polluting water. Tell the kids to write "guilty" or "innocent" on the line following each character's description. Then, on the back of copies of page 19, have students write a short explanation of their verdict. Tell them to include the numbers of the hints used to reach their answer. Hints may be used more than once.

Go over page 19 with the class, using the answers on this page. Be sure to explain that some of the people's actions might not affect overall water quality very much by themselves. However, if a lot of people in the area acted in those ways, the cumulative effect could be disastrous.

Next, discuss how all of us, like people from Granville, are "guilty" of polluting water without thinking about it. Every time we send cans from paint or other household chemicals to the landfill, use garden pesticides or do any number of other things that eventually involve water, we contribute to water-pollution problems. Then ask the class if they'd like to add anything to the list of ways water gets polluted.

Finally, ask the class what the characters on page 19 might do to reduce their effect on water quality. (Joe—use fewer and less-toxic pesticides; use natural insect predators to help control pest insects; make sure cows graze away from the stream. Leila—use collecting pans to catch liquids emptying from the car; take used motor oil and antifreeze to a collection center for recycling or to a hazardous-waste collection center or to Granville's annual hazardous waste collection in the elementary school parking lot; soak up any spilled toxics with cat litter and then take the litter to a hazardous-waste collection center. Michi—switch to non-toxic lawn care. Martha—periodically check the underground storage tank for leaks; upgrade tank so it won't corrode. Sabina—get a list from the library or town hall of the household substances that can pollute water; save old cans and jars of them for the annual hazardous-waste collection day.)

ANSWERS:

Fact numbers are in parentheses. Depending on how inventive the students are, they may find connections to facts on the copycat page besides the main connections listed below.

Joe Ramos—guilty. To grow "perfect" fruit and vegetables, Joe most likely uses lots of pesticides and fertilizers (12). Rain or snowmelt can carry these into water (1), or pesticides may soak into the soil and contaminate groundwater (1, 11). Fertilizers washing into the water and waste from cows grazing next to Davies Creek may cause big algae blooms, which "steal" oxygen from the water (9).

Leila Khalil—guilty. When Leila dumps her used motor oil down the storm drain, the oil eventually flows into a waterway (1). Hosing off the driveway also puts oil in the waterways (1). Oil can poison animals that live in water (10).

Michi Akizawa—guilty. Michi most likely uses chemical fertilizers and pesticides to keep lawns thick and green (4). Rain or snowmelt may then wash these chemicals into waterways (1), or the chemicals may soak into the soil and contaminate groundwater (11).

Martha Stone—guilty. Martha Stone's gas station has an underground gasoline storage tank (5). Gasoline could be leaking from this tank since it has not been replaced or repaired since 1953 (7, 8, and the "1953" written in the cement that's mentioned in the description). Gasoline leaks could taint groundwater (10, 11).

Sabina Karowski—guilty. The hazardous chemicals that Sabina pours down the toilet will probably end up polluting water (2, 3, 6, 13).

Action Tip!

Your class can help a local stream or river by organizing a cleanup, setting up a monitoring program or publicizing problems. For help, contact:

Save Our Streams
Izaak Walton League
1401 Wilson Blvd., Level B
Arlington, VA 22209

Green (Global Rivers Environmental Education Network)
216 S. State St., Suite 4
Ann Arbor, MI 48104

COPYCAT PAGE: *Guilty or Innocent?* - A3.9

Hints for "Guilty or Innocent?"

1. Rain and snowmelt can wash off the land directly into streams, lakes and other waterways. The water can also flow into storm drains. In most communities in the U.S., these storm drains connect to pipes that empty into waterways.

2. In most areas of the country, whatever goes down people's toilets and drains will travel to septic tanks or a sewage treatment plant.

3. Sewage treatment plants can clean out some water pollutants—like organisms that cause disease. After treatment, water goes to a river or other waterway.

4. Often, lawns that look thick and green have been treated with fertilizers and toxic pesticides.

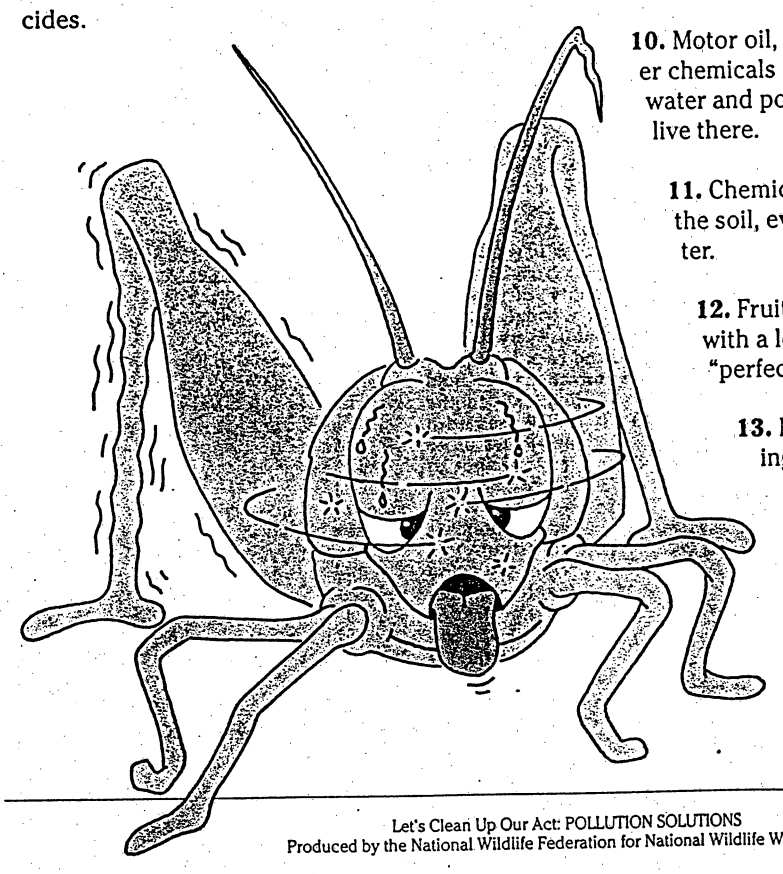
5. Gas stations store gasoline in underground tanks.

6. Most sewage treatment plants can't remove all the harmful chemicals from wastewater.

7. Gasoline storage tanks often develop leaks after about 20 years.

8. To repair or replace a leaking gasoline storage tank, someone must dig up the tank.

9. Fertilizers from farms and waste from cows and other livestock can wash into streams and provide a big meal for algae. The algae grow like crazy and then die and rot, using up oxygen that other water creatures need.



10. Motor oil, antifreeze, gasoline and other chemicals from cars can get get into water and poison other creatures that live there.

11. Chemicals can soak down through the soil, eventually dirtying groundwater.

12. Fruits and vegetables grown with a lot of pesticides often look "perfect."

13. Many home-repair and cleaning chemicals contain toxins that sewage treatment plants can't remove. These chemicals include common substances like paint thinners, wood preservatives, rust removers and varnish.

Let's Clean Up Our Act: POLLUTION SOLUTIONS
Produced by the National Wildlife Federation for National Wildlife Week 1994

Out of Balance

Objective: In a physical education format students will demonstrate a system that is out of balance.

Materials: 7 9-12" soft balls
7 3X5" cards and marker or erasable marker
tape

Procedure:

1. Write one the following words on each of the cards: balance, litter, oil, toxic waste, heat, pesticides, soil. (Students should be familiar with these terms and their effect as water pollutants from previous activities. Review terms. If unfamiliar, explain terms.)
2. Tape card to ball. (Or write on balls with erasable markers.)
3. Have class stand in a large circle.
4. Using the balance ball, demonstrate how to toss the ball gently underhand.
5. A pattern needs to be set up. Explain that each person always tosses to the same person, so each person always receives from the same person.
6. Begin the pattern slowly, reminding students to remember who throws to them and to whom they throw to.
7. Proceed until everyone has had a turn. Repeat one or two more times so that all students are clear to whom they throw.
8. Explain that this is a river or pond in balance. Everyone does its part. (If you have any student continually disrupting the "river," you can not allow them to participate, explaining that is for the health of the river.)
9. Once the river is in balance, the teacher as disruptions or changes to the river's balance. This is done by tossing in the other balls slowly, one by one, calling out the name of the pollutant you are adding to the river. Remind students to keep throwing to the same person all of the time.
10. As balls are added the river's balance is disrupted. The students will want to repeat the process.

Discussion:

Was the river ever in balance? What does that mean?
What types of things can get a river out of balance? How?
What happens when something is out of balance?

River Clean-up

3.11

Objectives: Students will develop a system to clean the polluted water from the *Fred the Fish* activity.

Materials:

River Clean-up Worksheet (One per student)

"Polluted water"	2 cups per group
pebbles	netting
cotton balls	leaves
gravel	items of students' choice

Engage: Read the class eulogy to Fred the Fish to remind students of how the river was polluted. Then read *The Magic School Bus at the Waterworks* by Joanna Cole. Pay particular attention to the sections that deal with water clean up.

Procedure:

1. Show students the settled water. Would the things in the river ever settle out in nature? Where? (In a quiet pool on the river or a lake.) Relate the settling to one of the means of purifying or cleaning water. There are settling ponds or basins as a part of water purification or clean up.

2. Mix river water well. Ask the students if that would happen in reality and why. (The natural flow of a river churns up whatever is in it.)

3. Instruct students to make a plan on their worksheets to clean the water.

4. Students should set up their group system.

5. Give each group one cup of the polluted water to clean.

6. Each group fills out the worksheets and draws their set up.

Closure: Groups will show their set up and the resulting water.

River Clean-up

3.11

Hypothesis: Plan your filtration system. Why are you making it this way?

_____

_____

_____

List needed materials.

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

Vol. of water at start =___ ml end =___ ml Difference =___ml

Procedure: List the steps you will follow.

_____

_____

_____

On the back **draw** a **picture** of your system.
How clear is your water? Results:

_____

_____

_____

How might you change your system to make it better?

_____

_____

_____

Adapted from "Just a Dream" lesson by Greg Ferguson

ACTIVITY: TOUGH CHOICES

Debate several issues relating to solid waste and hazardous substances.

OBJECTIVES:
Identify and debate several consumer issues relating to solid waste and hazardous substances. List the steps involved in making an environmentally sound decision.

GRADE LEVEL:
Advanced

MATERIALS:
- *Chalkboard or easel*
- *Paper*
- *Research materials*

SUBJECTS:
Language Arts
Science
Social Studies

DEBATE POINTERS

•Make sure your arguments are clearly stated, logical and well supported by evidence.
•Explain why your arguments are important. Use examples when possible.
•Make your most important points first, and don't jump from one argument to another.
•Speak slowly and clearly so that others can follow what you're saying. Be relaxed and poised.
•Be convincing and creative.

Making environmentally sound choices isn't easy. For example, which is better for the environment: paper or plastic bags? Many of the choices involve complicated issues and tough trade-offs. The overall benefits of one choice over another aren't always clear.

Have your students research and debate several issues to identify the environmental pros and cons of different options and discuss the trade-offs involved with solid-waste decisions.

GETTING READY:

Divide the group into discussion teams and assign each team one of the issues on page 6, "Discussion." Explain that each team will be staging a debate on their topic and members should decide which point of view they want to support. (If individuals have difficulty choosing a position or if issue positions aren't evenly represented, have the team members draw sides to make it fair.) Some team members might have to argue for a position opposite to the one they support. Point out that in this case they will learn how to develop and support arguments defending a specific point of view. It will also expand their understanding of the issues. Explain that when the debates take place, both sides will have a chance to present their case and rebut what the other team says.

To prepare for the debate, have team members research their topics. Current periodicals and newspaper articles are helpful in compiling information to understand the intricacies of each alternative. Debaters need to present facts that support their arguments. (A list of the pros and cons on the following page will help you guide their research.)

Before starting, set a time limit for each debate and review the "Debate Pointers" with the group. You might also want to set up a debate format as follows: 1. first group presents its case; 2. second group presents its case; 3. first group rebuts and adds arguments; 4. second group rebuts and adds arguments.

Explain that the observers have an important role during debates in assessing the arguments and formulating their own points of view. Observers should consider these questions:
•Were the arguments convincing? Do you think the information used to support the case was reliable? Why or why not?
•Were any important issues not addressed?
•Do you feel that one option is better for the environment than another? Why or why not?
•Do you feel that you need additional information before you can decide which position you support? If so, what information would you need and from what source would you obtain it?
•Which team's argument was the most persuasive and why?

After each debate, ask the observers to comment on the points they were instructed to keep in mind. (See "Current Thinking" for other perspectives to consider.) Ask the debaters for their reactions to the debate. In addition, have the group think about other options that were not presented and discuss them.

Also point out that for many questions there's not one right or wrong answer. Many issues are complex and involve many social and economic aspects, and decisions often involve trade-offs. Experts often don't agree on what the best option is. Individuals need to make decisions using facts and their own value systems.

As a wrap-up, have the group come up with a short checklist for making an environmentally sound choice. The list might include:
•Find out as much as you can about the different options from reliable resources.
•Decide who would benefit and who would be harmed by each of the options (Think about short- and long-term consequences.)
•Learn how each option would affect the environment and people around the world.
•Make a list of pros and cons for each option.

CURRENT THINKING:

Issue 1
Environmentalists recommend that shoppers bring reusable cloth bags to the store instead of getting new paper or plastic bags each time. Some experts say paper and plastic are equally harmful and that if you use either you should make sure to reuse or recycle them. Others choose paper because it's derived from a renewable resource.

Issue 2
Most environmentalists aren't in favor of most types of plastic packaging, including plastic soda bottles. The current recommended action is to choose glass instead of plastic and to recycle glass. Although plastic has its problems, it is here to stay. Therefore, plastic recycling efforts are important.

Issue 3
Many waste experts feel that we need to recycle as much as 65 percent of our garbage to handle our solid-waste problems and that putting a freeze on building new incinerators and landfills would help promote the reduction, reuse and recycling of solid waste.

Some people argue that well-managed landfills are more ecologically sound than incinerators. Others say incinerators and landfills are equally bad, though people acknowledge that both will continue to play an important role in waste disposal.

Issue 4
Environmentalists favor organic lawn care and encourage landscaping with native plants to save water and attract wildlife.

DISCUSSION:

TOUGH CHOICES

ISSUE 1: *Bag It!*

When given an option, should you choose a paper or plastic bag for your groceries?

Paper bags
pros: made from a renewable resource; biodegradable; reusable.
cons: most are at least partially made from virgin fiber instead of recycled paper; timber is usually grown as a sterile monoculture with fertilizers and pesticides; paper manufacturing releases more toxins and other pollutants into air and water than plastic production; paper is bulky and takes up more space in transport, storage and landfills than plastic.

Plastic bags
pros: cheaper to manufacture; take up less transport, storage and landfill space; recyclable; reusable; some are made with petroleum waste products.
cons: can harm wildlife; most plastic made from nonrenewable (petroleum, particularly natural gas) resources; manufacturing releases toxins and other pollutants into air and water.

Incinerators
pros: greatly reduce volume of trash; save landfill space; can recover energy and resources; reduce the threat of rat, roach and other pest infestations.
cons: expensive to build; may discourage people from recycling (need a high volume of garbage to operate); create toxic air pollution; creates toxic ash that can leach into water supplies when landfilled; people don't want them nearby; require separation of trash into burnables and nonburnables.

Landfills
pros: easy because waste doesn't need to be separated or sorted; generate methane gas that can be recovered for fuel; can sometimes reuse site (through reclamation) for other purposes.
cons: hazardous materials can pollute area and leach into water supplies; generate methane gas that can cause explosion if not vented; take up valuable land space; buried biodegradable materials don't degrade; buried resources are wasted; people don't want them nearby.

ISSUE 2: *Soda Sense*

Should you buy sodas in plastic or glass bottles?

Plastic bottles
pros: cheap; lightweight; unbreakable; recyclable in some areas; relatively inert in landfills.
cons: made from nonrenewable resources; nonbiodegradable; variety of plastic materials makes collection and sorting difficult; poor market for post-consumer plastics; manufacturing creates air and water pollution; recycled plastic not as durable as virgin plastic.

Glass bottles
pros: cheaper and easier to recycle; can be reused and recycled; made from abundant natural resources.
cons: heavy; breakable; nonbiodegradable; cost more to transport; recycling uses a lot of water and can create water pollution.

ISSUE 3: *Waste Woes*

Which is the better alternative for disposing of the solid waste we don't recycle: burning it in incinerators or dumping it in landfills?

ISSUE 4: *Growing Dilemma*

Should homeowners use chemical lawn services or rely on organic lawn care? (Note: organic lawn care uses no toxic herbicides and pesticides and no synthetic fertilizers. People can either take care of their lawns themselves, using organic methods or hire organic landscaping services.)

Chemical lawn care
pros: effective in short term for controlling pests; provides "manicured" look; easy.
cons: expensive; long-term effects not clear; chemicals made from nonrenewable resources; chemicals wash off in rain and pollute water supplies; chemicals can build up in soil and also poison people, pets and wildlife; manufacturing and transporting chemicals can create pollution.

Organic lawn care
pros: nontoxic, can be less expensive; maintains and enhances ecological life-support systems; causes less pollution.
cons: hard work if professionals are not hired; short-term pest control may not be effective.

Are You Part of the Problem?

Objective: *Discuss how individual actions can affect habitats.*
Ages: *Advanced*
Materials: *Copies of page 6*
Subjects: *Science and Social Studies*

It's easy to think that only businesses and governments cause habitat destruction. But individuals also contribute to the problem. In this activity, your kids can discover how people's actions in the United States can affect habitats around the world.

Begin by asking the kids to name some of the reasons why habitats are being destroyed. (to make room for houses and other development; to clear land for farming; to supply materials for industries such as logging and mining; and so on) List their ideas where everyone can see them. Then ask the kids if they think that some of the things they do contribute to habitat destruction. If they say yes, ask them to explain how.

Next pass out copies of the discussion questions on page 6 and have the kids break up into small groups to discuss each question as honestly as they can. Use the information under "Answers and Ideas" to talk about the kids' answers. Also discuss how the actions of individuals can directly and indirectly affect habitats. For example, by buying certain kinds of tropical fish, people may contribute to the destruction of coral reefs and the creatures that live there. And by purchasing products made by companies that cut down rain forests, consumers indirectly play a part in the loss of these forests.

(Adapted from "Are You Part of the Problem?" on pages 56–57 of *NatureScope—Rain Forests: Tropical Treasures.*)

ANSWERS AND IDEAS

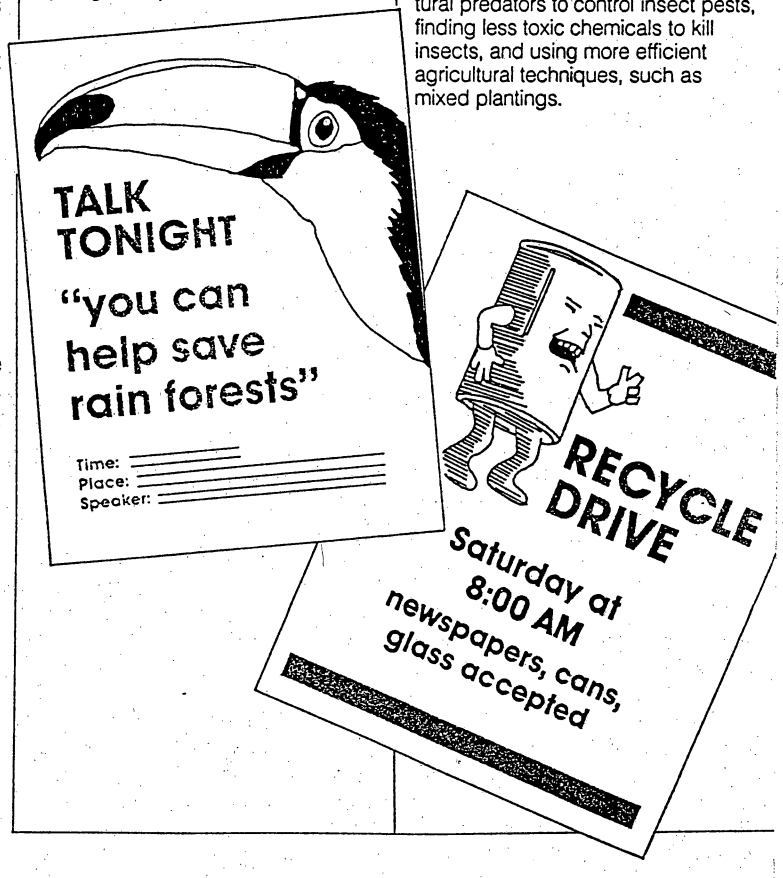
1. Opinions will vary on the first question. Ways to inform other consumers include putting up posters in libraries and other public places, writing an article for the school newspaper, and writing a letter to the editor of an aquarium magazine or another publication involved with the aquarium pet industry.

2. Forests are cut down to harvest wood, which is used to make paper, building materials, and other products; oceans may be polluted when oil is spilled during transit; strip mining can erode topsoil and pollute water. Recycling paper can help conserve trees; recycling some kinds of plastic can conserve oil; and recycling aluminum can save energy and reduce the need for mining to collect bauxite, the ore used to make aluminum. You can start a recycling drive in your school or community. (See page 14 for tips on organizing a recycling drive.)

3. By boycotting a product, an individual stands up for what he or she believes in and can tell others about the problems associated with the product. Ways to convince others include telling them about the plants and animals that live in rain forests, explaining the effects of rain forest destruction, and pointing out the possibility of discovering new kinds of medicines and other products in rain forests. (For more about tropical rain forests, see *NatureScope—Rain Forests: Tropical Treasures.)*

4. To make a decision, you might need to know what kinds of plants and animals depend on wetlands for survival, how wetlands are useful to people, and what can happen when wetlands are destroyed. (For more information and activities about wetlands, see *NatureScope—Wading into Wetlands.)*

5. Other options include using natural predators to control insect pests, finding less toxic chemicals to kill insects, and using more efficient agricultural techniques, such as mixed plantings.



PROBLEMS AND SOLUTIONS

3.13

1. Many people buy tropical fish from pet stores for their saltwater aquariums at home. These saltwater fish are often taken from the waters around coral reefs. Many of these saltwater fish are legally captured by divers. But sometimes divers illegally use poison to weaken the fish to make them easier to catch. Many of the captured fish die before reaching the stores. The poison also harms other animals that live around the reefs.

A. Do you feel that saltwater fish should be kept as pets? Why or why not?
B. What are some ways you could inform other consumers about the problems associated with collecting saltwater fish?

2. The United States has only about 4 percent of the world's population. Yet we use many times that amount of the world's resources, such as wood, energy, and food.

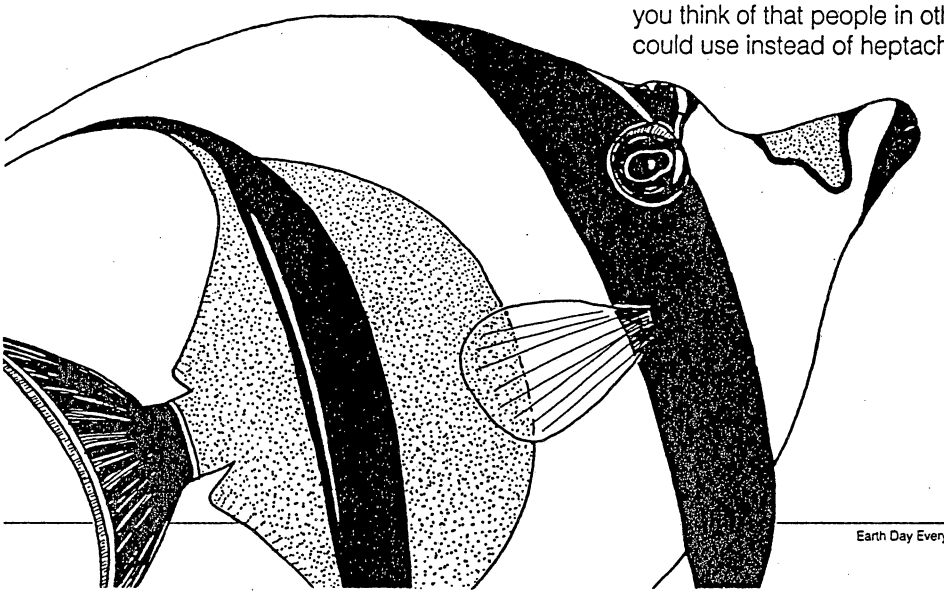
A. What are some of the ways that this enormous use of resources can contribute to habitat destruction?
B. Can you think of some ways that recycling materials in the United States might help protect habitats here and in other parts of the world?
C. What could you do at home or at school to help promote recycling and other forms of conservation?

3. If you knew that your favorite type of soda was produced by a company that was supporting the destruction of tropical rain forests, would you stop buying it? What do you think the value is of one person boycotting a product? Would you try to get your friends to stop buying the soda? If so, how would you convince them?

4. Would you spend any of your own money on a project to help protect wetlands such as marshes and swamps? Why or why not? What information would you need to help you decide whether to spend your money to help protect wetlands?

5. In 1987, the U.S. government prohibited the use of the pesticide heptachlor in this country. Heptachlor was banned in the United States because it is so dangerous to wildlife and people. It can cause cancer and can remain in the environment for decades. One U.S. company still manufactures heptachlor to sell to other countries. People in these countries use heptachlor to control termites, ants, and other insects. Sometimes heptachlor ends up in food that people in these countries eat, and in food that is shipped to the United States.

A. How do you feel about a U.S. company selling heptachlor to other countries?
B. What alternative methods of pest control can you think of that people in other countries could use instead of heptachlor?



A Heated Controversy

Read and discuss two articles about global climate change.

Objectives:
Discuss the causes and possible effects of global climate change. Explain why it's important for individuals to be aware of current issues in science.

Ages:
Advanced

Materials:
- ***copies of pages 54 and 55***

Subjects:
Science, Social Studies, and Language Arts

By reading two articles about global climate change, your kids can learn more about how some air pollutants may be affecting our climate. Begin by asking the kids to tell you what they know about global climate change, often referred to as "global warming." Then use the background information under "Changing the Face of the Earth" on page 34 to talk about the greenhouse effect and greenhouse gases, such as carbon dioxide and CFCs.

Next explain that although most scientists agree that the increasing amounts of carbon dioxide, CFCs, methane, and other greenhouse gases in the atmosphere will affect the world's climate, there's some disagreement about whether these changes have already begun and how serious the effects will be. Scientists also disagree on how we should react to global climate change.

Now pass out paper and copies of pages 54 and 55 to each person and explain that each of these articles expresses a point of view about global climate change. (Neither article was written by a real scientist, but both points of view have been expressed by people in the scientific community.) Give the kids time to read the articles and answer the questions that follow the second one. Afterward discuss the kids' answers using the information under "Is the Heat Really On?" and "A Look at the Facts" on page 46. Finish up by having the kids brainstorm some ways that they can help reduce the amount of greenhouse gases that are being released into the atmosphere. (bike, walk, carpool, or take public transportation whenever possible and encourage friends and family to do the same; conserve electricity and buy energy-efficient appliances; don't buy products made with CFCs; encourage parents to have car air conditioners serviced at stations that can recycle coolant made with CFCs and to have home and car air conditioners checked for leaks)

(continued next page

A Heated Controversy/1

3.14

Scientist 1

It's time to face the facts—the increasing amounts of carbon dioxide and CFCs in the atmosphere are making our planet's climate warm up. We've seen the warning signs in our increasing world temperatures. The 1980s were the hottest decade in recorded history—six of the warmest years ever recorded were 1981, 1983, 1986, 1987, 1988, and 1989. While this isn't proof that global warming has begun, it certainly should warn us that something is happening to our climate.

Over the past 100 years, average world temperatures have risen by about 1°F. That may not seem like much of an increase, but keep in mind that temperatures today are only about 9°F warmer than they were during the last ice age. It takes only a small change in temperature to cause big changes in our world. And if we continue to put as much carbon dioxide into the atmosphere as we're putting into it now, the world's average temperature may increase by 3 to 10°F within the next 50 years.

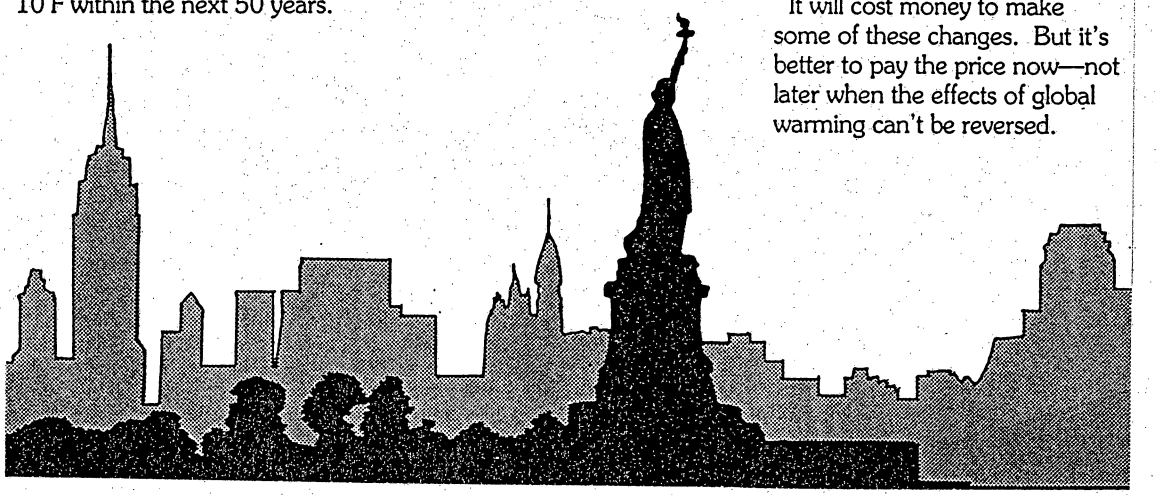
If temperatures do rise, we can expect some drastic changes to take place. As temperatures go up, sea levels will rise and many coastal areas will become flooded. The warming could make droughts occur more often in certain areas. Some places, like the Midwest, could become so hot and dry that many crops couldn't grow there anymore. And all over the world, plants and animals may not be able to adapt quickly enough to the sudden changes in their habitats. Some species could even become extinct.

Some people claim that we should wait until we're absolutely sure of global warming before we do anything to control it. I disagree. If we wait too long, it may be too late to prevent damage from the warming trend.

We must cut carbon dioxide production by at least 20 percent and phase out CFCs *now*. And since people in the United States produce a lot of the carbon dioxide and CFCs that go into the air, we have to set an example for the rest of the world. We must develop safer chemicals to replace CFCs. We have to switch to solar power and other alternative energy sources. And until we make that switch, we have to use less fossil fuel and become more energy efficient. Industries that continue to use coal and other fossil fuels should be taxed for the excessive carbon dioxide they release. A tax should also be placed on gasoline to encourage people to drive less. And car makers should be required by law to make cars that get better gas mileage.

Individuals must do their part too, by taking public transportation instead of driving their cars so much and by buying more energy-efficient appliances and cars. And we have to stop the burning of tropical rain forests. By preserving these forests, we can reduce carbon dioxide emissions caused by the burning *and* save the trees and other vegetation that help absorb carbon dioxide.

It will cost money to make some of these changes. But it's better to pay the price now—not later when the effects of global warming can't be reversed.



COPYCAT PAGE — A HEATED CONTROVERSY/2 — 3.14

SCIENTIST 2

There's been a lot of concern lately that the world's climate is warming up. Some scientists say that the increased amounts of carbon dioxide and CFCs in the atmosphere are causing this global warming. According to them, the only way to avoid global disaster is to cut carbon dioxide emissions by at least 20 percent—a move that would affect people all over the world.

I say there's not enough scientific evidence to back up this call for drastic action. Let's consider the facts. It is true that there's more carbon dioxide in our atmosphere than there used to be and that we have added gases, such as CFCs, that were never part of our atmosphere before. But there's just not enough evidence to prove that these gases are making the world warm up. In the past 100 years, average world temperatures have risen by only 1°F. And this hasn't been a constant rise—between 1940 and 1970, world temperatures actually dropped, and some scientists suggested that another ice age might be on the way. This latest rise could be just another small change in a natural climate cycle.

It's very important to keep in mind that many of the predictions about the effects of global warming are based on *theory*. Scientists have come up with these predictions by plugging information about our atmosphere into computers. The computers make predictions about what will happen if we add certain amounts of carbon dioxide and other gases. The problem is, different computer models can give you different answers! Some models have predicted that the increase in carbon dioxide will cause more clouds to form. These clouds would block sunlight and cancel out much of the warming. And, according to other models, it's possible that the earth's huge oceans will absorb any extra heat. We just don't know enough yet about how our atmosphere works.

Because of this uncertainty about what is really happening in our atmosphere, I believe we need to do more research before we make any big changes. To significantly cut the amount of carbon dioxide we put into the atmosphere would make life harder for many people—especially those living in less developed countries. How can we ask them to cut back on releasing carbon dioxide when they're just now getting the cars and factories that people in more developed countries have had for so long? And in the United States, cutting carbon dioxide production would cost billions of dollars each year. Forcing industries to stop using fossil fuels might drive some smaller firms out of business and hurt people in regions where coal mining provides many jobs. We must do more research before we make changes that, in the end, may cause more harm than good.

QUESTIONS

1. What are the main points brought up by each scientist?

2. What are the advantages and disadvantages of the alternative presented by Scientist 1?

3. What are the advantages and disadvantages of the alternative presented by Scientist 2?

4. Can you think of a course of action that is a compromise between the two plans presented by the scientists?

5. What do you think is the best course of action? Why do you feel this is the best thing to do?

6. Do you think it's important to stay informed about scientific issues? Why or why not? What are some ways you can affect the decisions that politicians and other leaders make about the environment?

COPYCAT PAGE: *Away on the Bay* 3.16

This is the tale of a town called *Away*—
A town that was built on the shore of a bay.
A town where the folks didn't think much about
What they dumped in their water, day in and day out.

For one thing, a sink was an excellent place
To get rid of messes and not leave a trace.
Cleansers and cleaners and yesterday's lunch
Went ***away*** down the drain with a gurgly crunch.

On Main Street each day there were sidewalks to sweep.
The litter and dirt were swept into the street.
And then when it rained, everything washed ***away***
Into drains in the roads that dumped into the bay.

A mill there made "stuff" for the townfolks to use,
But a pipe from the mill churned out oodles of ooze.
And the ooze, well, it goozed from the pipe to the bay
Where it bubbled and glubbed as it drifted ***away.***

When the weather was warm, it was always a treat
To sail on the bay and bring picnics to eat.
But when folks were finished, they'd toss all their trash
Overboard and ***away*** with a plop and a splash.

Then folks started seeing that things weren't quite right;
The bay had become an unbearable sight.
Beaches were covered with garbage and glop
That rolled in with the waves—and the waves didn't stop.

The fish in the bay all seemed sluggish and sick,
The algae was everywhere—slimy and thick.
The birds near *Away* were all suffering too,
'Cause the fish they were eating were covered with goo.

So a meeting was called to discuss the sick bay,
And townspeople came from all parts of ***Away.***
And during the meeting one person proclaimed,
"I know who's at fault: We ***all*** should be blamed."

"For years we've washed chemicals, dirt and debris
Down our sinks, off our streets and out pipes— so you see,
Although we all thought that our waste went ***away***,
It all ended up going into the bay."

"Now the bay is a mess—full of trash, junk and goop,
The water's turned green—like a bowl of pea soup.
And our wildlife is sick from the garbage and grime;
The bay needs our help, right now while there's time."

The folks were all silent—they knew it was true.
And they realized now what they all had to do.
It was time to get busy—the bay couldn't wait.
If they didn't act now, it might soon be too late.

So they signed an agreement that very same minute
To care for the bay and to stop putting in it
The stuff that had made the bay icky and ill,
Like trash that pollutes and the ooze from the mill.

They also agreed to stop dumping their trash
Overboard and ***away*** with a plop and a splash.
And all of their efforts have been a success:
Today the bay's clean and no longer a mess.

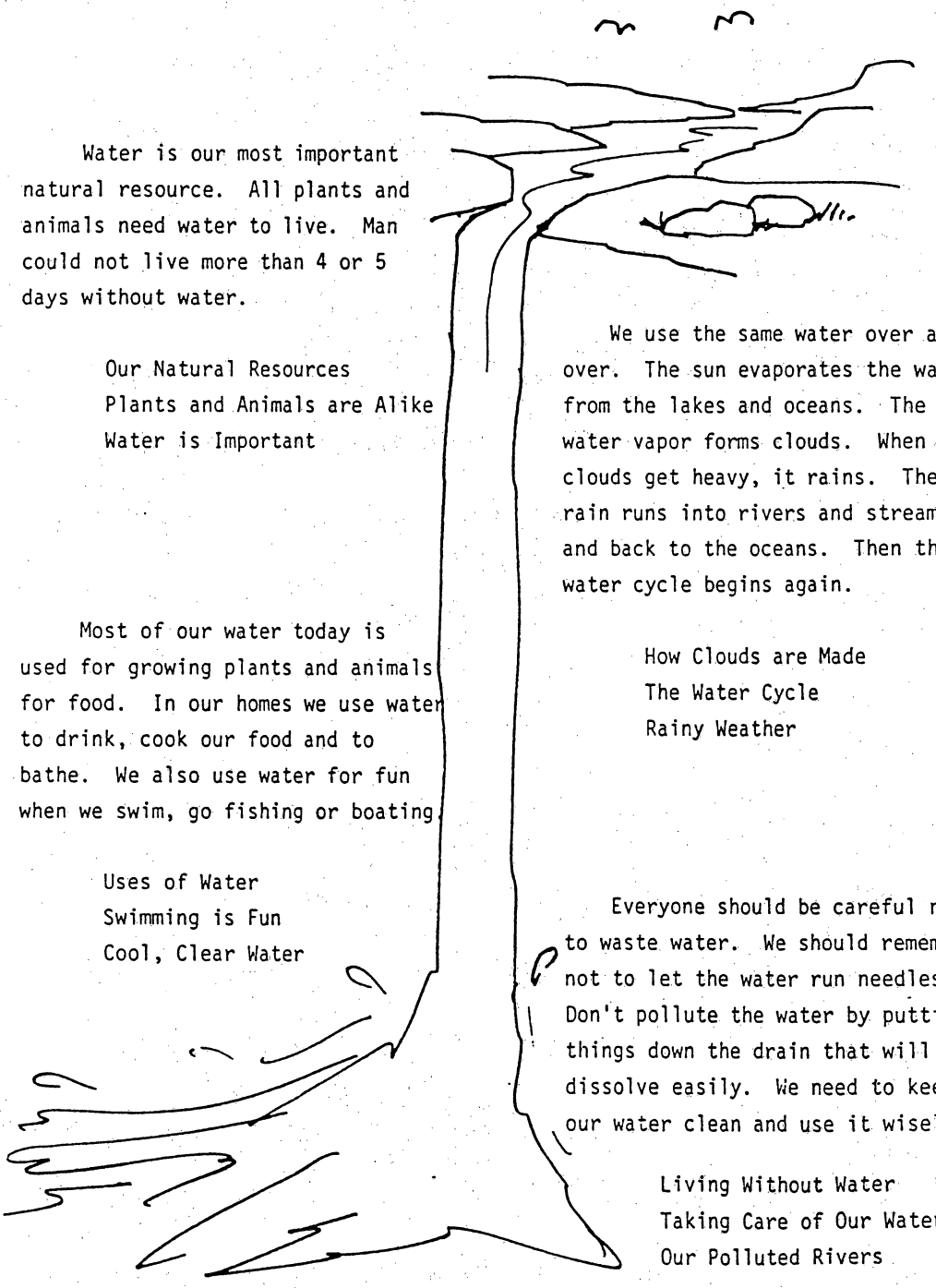
And that is the tale of the town called *Away*—
A town where the people, to this very day,
Remember a saying that's simple and plain:
Nothing just goes ***away*** when it's washed down the drain.

Let's Clean Up Our Act: POLLUTION SOLUTIONS
Produced by the National Wildlife Federation for National Wildlife Week 1994

Choose the Best Title

3.17

Directions: Read each story. Choose the best title and draw a line under it.



Water is our most important natural resource. All plants and animals need water to live. Man could not live more than 4 or 5 days without water.

Our Natural Resources
Plants and Animals are Alike
Water is Important

We use the same water over and over. The sun evaporates the water from the lakes and oceans. The water vapor forms clouds. When the clouds get heavy, it rains. The rain runs into rivers and streams and back to the oceans. Then the water cycle begins again.

How Clouds are Made
The Water Cycle
Rainy Weather

Most of our water today is used for growing plants and animals for food. In our homes we use water to drink, cook our food and to bathe. We also use water for fun when we swim, go fishing or boating.

Uses of Water
Swimming is Fun
Cool, Clear Water

Everyone should be careful not to waste water. We should remember not to let the water run needlessly. Don't pollute the water by putting things down the drain that will not dissolve easily. We need to keep our water clean and use it wisely.

Living Without Water
Taking Care of Our Water
Our Polluted Rivers

DEADLY LINKS 3.18

Objectives

Students will be able to: 1) give examples of ways in which pesticides enter food chains; and 2) describe possible consequences of pesticides entering food chains.

Method

Students become "hawks," "shrews," and "grasshoppers" in a highly-involving physical activity.

Background

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

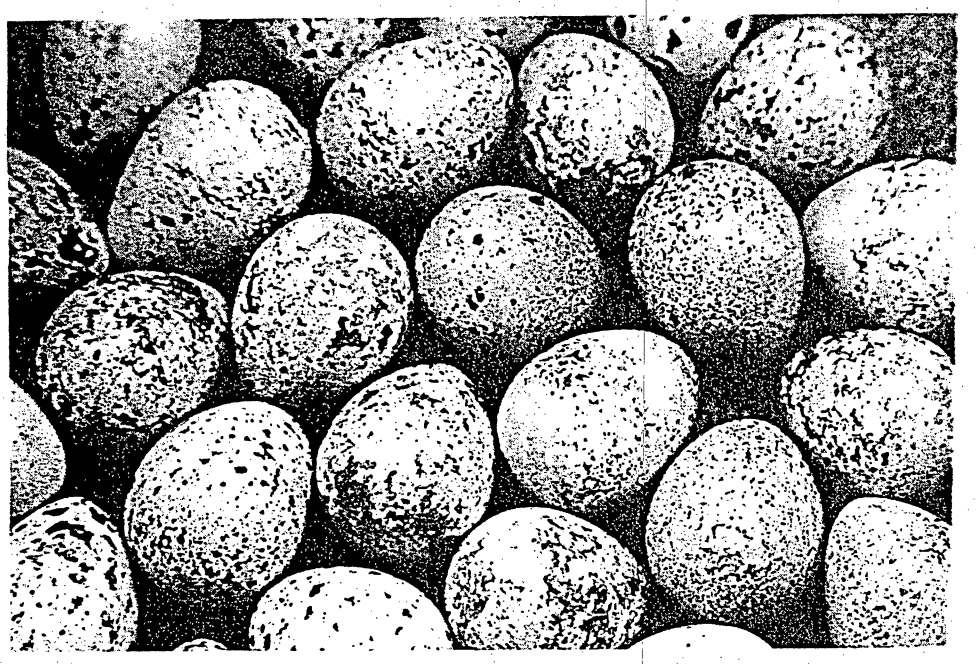
For example, a pesticide (a chemical—frequently synthesized from inorganic compounds—used to kill something identified as a "pest" under some conditions) called DDT used to be applied regularly to crops as a means of controlling insects that were damaging the plants or trees. Then

Age: Grades 4-9
Subjects: Social Studies, Science, Physical Education
Skills: analysis, classification, comparing similarities and differences, computation, description, discussion, evaluation, generalization, kinesthetic concept development, synthesis
Duration: one 30-45 minute period
Group Size: minimum of ten students preferred
Setting: large playing area
Conceptual Framework Reference: I.C., I.C.3., I.C.4., I.D., II.B.2., II.B.3., II.B.4., III.B., III.B.1., III.B.2., IV.A.4., IV.C.3., VI.A., VI.A.2., VI.A.3., VI.A.4., VI.A.5., VI.B., VI.B.1., VI.B.2., VI.B.3. VI.C., VI.C.1., VI.C.6., VI.C.12., VI.C.13., VI.C.14., VI.C.15., VI.C.16., VI.D., VII.A.2., VII.A.4., VII.B., VII.B.1., VII.B.2., VII.B.3., VII.B.4., VII.B.5., VII.B.6., VII.B.7.
Key Vocabulary: pesticide, insecticide, herbicide, food chain, accumulate, toxic, chemicals, trade-offs, organic, inorganic

it was discovered that DDT entered the food chain with damaging results. For example, fish ate insects that were sprayed by the chemical; hawks, eagles, and pelicans ate the fish. The poisons became concentrated in the birds—sometimes weakening and killing them directly, and over time resulting in side effects like egg shells so thin that the eggs would not hatch, or were crushed by the parents in the nesting process. The impact on species, including the bald eagle and the brown pelican, has been well documented. Use of DDT has now been prohibited by law in the United States; however, at least one temporary waiver was granted in recent years to allow its limited use. It has not been prohibited worldwide, and therefore still enters the food chain.

settle into the soil, or stay on the crop, until i is washed by rain or irrigation into other wate sources like groundwater, lakes, streams, rivers and oceans. Testing the water after this has oc curred typically does not show a particularly hig concentration of these human-made chemicals- but testing the fish often does! Waterfowl an other species may also be affected—includin human beings, if people eat contaminated fis or waterfowl, for example. In other word wildlife and people become the concentrators c the pesticide because the chemicals do not pas out of their bodies but accumulate in the bodies over time.

The major purpose of this activity is for studen to recognize the consequences of accumulatic of some pesticides in the environment.



Damaging fertilizers as well as pesticides are used by many farmers as a part of the agricultural industry. Again, use of such chemicals—particularly the inorganic, synthesized compounds—has varying side effects. For example, a pesticide (either insecticide, to kill insects, or herbicide, to kill unwanted plants) may be sprayed or dusted on a crop. The pesticide may

Materials

white and colored p cleaners, one inch paper squares, six inch leng of yarn, or any other material that can be pic up by students easily; 30 pieces per each stud is recommended in a proportion of two-thi white to one-third colored pieces; one paper l per grasshopper (approximately 18-20)

Procedure

1. Tell the students that this is an activity about "food chains." If they are not familiar with the term, spend time in establishing a definition. (Food chain: a sequence or "chain" of living things in a community, based on one member of the community eating the member above it, and so forth; e.g., grasshopper eats plants like corn, shrews eat grasshoppers, hawks eat shrews.)
2. Divide the students into three groups. In a class of 26 students, there would be two "hawks," six "shrews," and 18 "grasshoppers." (Work with approximately three times as many shrews as hawks, and three times as many grasshoppers as shrews.) Optional: Have grasshoppers, hawks, and shrews labelled so they can easily be identified; e.g., arm ties for grasshoppers, red bandannas for "red-tail hawks" and brown arm ties for shrews.
3. Hand each "grasshopper" a small paper bag or other small container. The container is to represent the "stomach" of whatever animal is holding it.
4. With the students' eyes closed, or otherwise not watching where you place the "food," distribute the white and colored paper dots (or whatever material you use) around in a large open space. Outside on a playing field if it is not windy, or on a gymnasium floor will work; a classroom will also work if chairs and tables or desks can be moved back.
5. Give the students their instructions. The grasshoppers are the first to go looking for food. The hawks and shrews are to sit quietly on the sidelines watching the grasshoppers; after all, the hawks and shrews are predators, and are watching their prey! At a given signal, the grasshoppers are allowed to enter the area to collect food and place the food in their stomachs (the bags). The grasshoppers have to move quickly to gather food. At the end of **30 seconds**, the grasshoppers are to stop collecting food.
6. The shrews are now allowed to hunt the grasshoppers. The hawks are still on the sidelines quietly watching the activity. The amount of time available to the shrews to hunt grasshoppers should take into account the size area you are working in. In a classroom, 15 seconds may be enough time; on a large playing field, 60 seconds may be better. Each shrew should have time to catch one or more grasshoppers. Any grasshopper caught by a shrew—that is, tagged or touched by the shrew, must give its bag of food to the shrew and then sit on the sidelines.
7. The next time period (from 15 to 60 seconds, or whatever time you set) is time for the hawks to hunt for food. The same rules follow. Any shrews still alive may hunt for grasshoppers; grasshoppers are hunting for the food chips that represent corn or other plants; and the hawks are hunting for the shrews. If a hawk catches a shrew, the hawk gets the food bag and the shrew goes to the sidelines. At the end of the designated time period, ask all the students to come together in a circle, bringing whatever food bags they have with them.
8. Ask the students who are "dead," having been consumed, to identify what animal they are and what animal ate them. (If they are wearing labels, this will be obvious.) Next ask the hawks to empty their food bags out onto the floor or on a piece of paper where they can count the number of food pieces they have. They should count the total number of white food pieces and the total number of multi-colored food pieces they have in their food sacks. List any grasshoppers and the total number of white and multi-colored food pieces each has; list the number of shrews left and the number of white and multi-colored pieces each has; and finally, list the two hawks and the number of white and multi-colored food pieces each has.
9. Inform the students that there is something called a "pesticide" in the environment. This pesticide was sprayed onto the crop the grasshoppers were eating, in order to prevent a lot of damage by the grasshoppers. If there was a lot of crop damage by the grasshoppers, the farmers would have less of their crop to sell, and some people and domestic livestock might have less of that kind of food to eat—or it might cost more to buy it because a smaller quantity was available. This particular pesticide is one that is poisonous, accumulates in food chains, and stays in the environment for a long time. In this activity, all of the multi-colored food pieces represent the pesticide. All of the grasshoppers that were not eaten by shrews may now be considered dead, **if they have any multi-colored food pieces in their food supply.** Any shrews for which half or more of their food supply was multi-colored pieces would also be considered dead. The one hawk with the highest number of multi-colored food pieces will not die at this time; however, it has accumulated so much of the pesticide in its body that the egg shells produced by it and its mate during the next nesting season will be so thin that the eggs will not hatch successfully. The other hawks are not visibly affected at this time.

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

Extensions

1. Consider and discuss possible reasons for use of such chemicals. What are some of the trade-offs? What are some of the consequences?
2. Offer and discuss possible alternatives to uses of such chemicals in instances where it seems the negative consequences outweigh the benefits. For example, some farmers are successfully using organic techniques (e.g., sprays of organic, non-toxic substances; crop rotation; companion planting); biological controls (e.g., predatory insects); and genetic approaches (e.g., releasing sterile male insects of the "pest species") in efforts to minimize damages to their crops.
3. Find out what research is going on to develop and test effects of pest control efforts—from effects of possibly toxic chemicals, to non-toxic alternatives. With what impacts? Trade-offs? Potential?
4. Check newspapers for relevant local, national, or international examples of such issues.
5. Conduct the activity using different examples; e.g., people, shellfish.

Evaluation

Give three examples of ways in which pesticides could enter a food chain.

Discuss two possible consequences of pesticides entering the food chain for each of the examples you gave above.

An ecologist studied the presence of a toxic chemical in a lake. He found the water had one molecule of the chemical for every one billion molecules of water. This is called one part per billion (1ppb). The algae had one part per million (1ppm) of the toxic chemical. Small animals, called zooplankton, had 10 ppm. Small fish had 100 ppm. Large fish had 1,000 ppm. How do you explain this increase in this toxic chemical to 1,000 ppm for the large fish? Use a drawing to help support your answer.

The ecologist found the chemical was a pesticide which had been sprayed on cropland 100 miles away from the lake. How did so much of it get into the lake?

Skill Outcomes:

1. Identify methods and problems associated with waste disposal.
2. Identify hazardous products.

Concepts:

1. The production, distribution, and consumption of products create solid, liquid, and airborne wastes.
7. Most liquid waste is washed down drains and goes through wastewater treatment plants where it is reclaimed and reused or returned to the ground or ocean.
8. Liquid and solid waste on the ground gets washed down storm drains, which usually lead directly to rivers and oceans.
10. Creating so much waste and improperly disposing of waste pollute our environment and cause other environmental problems.

Vocabulary:

- **groundwater**—water that is under the earth's surface
- **reclaimed water**—wastewater that has been cleaned so that it can be used again
- **storm drains**—drains in the streets that carry rain water to rivers and oceans
- **wastewater treatment plant**—a place that cleans water that goes down our drains and toilets
- **water filtration plant**—a place where water is cleaned and treated before the water is piped into homes

Materials:

- Poster—*Water: Where Does It Go?*
- Mini-Poster—*Water: Where Does It Go?*
- Practice Exercise 1

Advance Preparation:

- Make a transparency of Take-Home Exercise 2, or on the chalkboard, list the water use activities from the exercise.
- Bring in a one-gallon container (e.g., milk bottle or water jug or bucket) and fill it with water.
- Display the *Water: Where Does It Go?* poster where all students can see it.
- Make a copy for each student of the *Water: Where Does It Go?* mini-poster
- Make a copy of Practice Exercise 1 (2 pages) for each student or each cooperative learning group. (To save paper, copy the pages back-to-back if possible.)

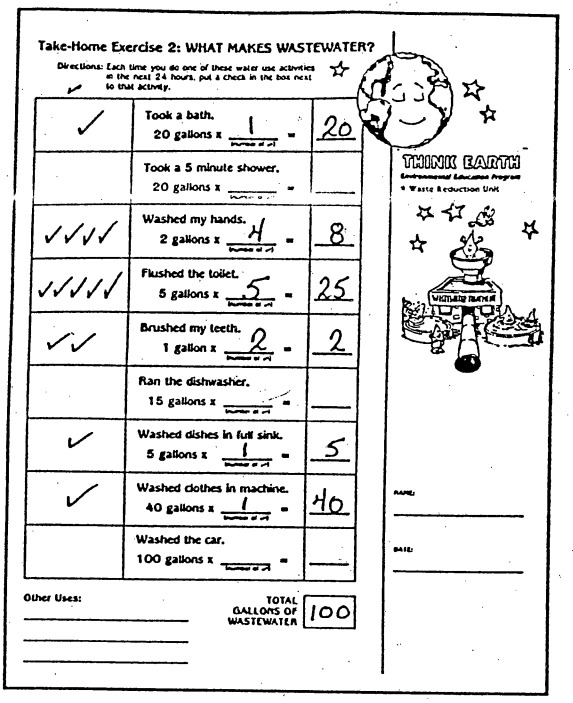
Procedures:

A. Discuss Take-Home Exercise 2

- Ask students to get out their Take-Home Exercise: *What Makes Wastewater?* Tell them that they are going to figure out approximately how much wastewater each of them created in a day.
- Show students a one gallon container filled with water to help them visualize how much a gallon is. Allow students to pick up the container to see how heavy it is.
- Tell students to multiply the number of times they did each activity by the number of gallons of water each activity uses. Work through an example on the chalkboard or on the transparency. *(Note: The sample on page 9 shows the average amount of wastewater created by each person everyday.)*
- Add all students' totals together for a "class total" of wastewater produced.
- Ask students if they know what happens to all that wastewater after it goes down their drains. Allow students to share ideas before moving on to the next activity.

B. Examine the *Water: Where Does It Go?* poster

- Give each student a copy of the *Water: Where Does It Go?* mini-poster and have students write their names on their posters. Explain that the mini-posters are the same as the large, full-color poster you've displayed.
- Explain to students that the poster shows where our water comes from and where it goes. Tell students that you are going to ask them some questions and that they can find most of the answers by looking at the poster.



Take-Home Exercise 2: WHAT MAKES WASTEWATER?

Directions: Each time you do one of these water use activities in the next 24 hours, put a check in the box next to that activity.

✓		
✓	Took a bath. 20 gallons x 1 =	20
	Took a 5 minute shower. 20 gallons x ___ =	___
✓✓✓✓	Washed my hands. 2 gallons x 4 =	8
✓✓✓✓✓	Flushed the toilet. 5 gallons x 5 =	25
✓✓	Brushed my teeth. 1 gallon x 2 =	2
	Ran the dishwasher. 15 gallons x ___ =	___
✓	Washed dishes in full sink. 5 gallons x 1 =	5
✓	Washed clothes in machine. 40 gallons x 1 =	40
	Washed the car. 100 gallons x ___ =	___

Other Uses: _____

TOTAL GALLONS OF WASTEWATER: 100

NAME: _____

DATE: _____

- Ask the following questions. Either you or a student can point out the appropriate sections on the big poster as the questions are answered. Tell students to pay attention to how the water drops change color.

1. **What happens to rain, snow, sleet, and hail that comes down to Earth?**
   (The water collects in rivers and lakes or sinks into the ground.)

2. **Where do we get the water we clean at a Water Filtration Plant?**
   (We get the water from rivers and lakes, and from under the ground.)

3. **Where does the water from the filtration plant go?**
   (It goes into homes, schools, and businesses where it is used for showering, cooking, mopping floors, flushing toilets, fighting fires, washing dishes, washing clothes, watering crops.)

4. **What happens to the wastewater that runs into the street?**
   (The water goes into storm drains.)

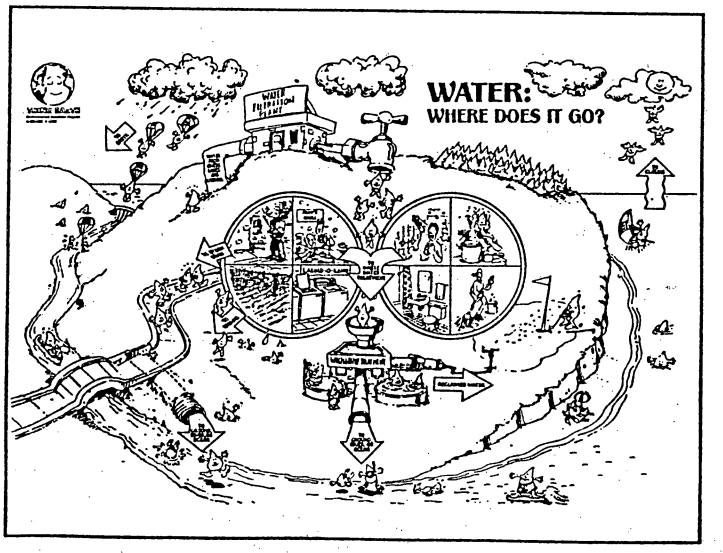
5. **Where do the storm drains lead?**
   (Water goes into pipes underground and gets released onto the ground or into rivers or oceans. It is usually not cleaned.)

6. **What problems do you think can be caused by water running down storm drains?**
   (The water picks up trash and other pollutants and carries them directly to rivers or oceans.)

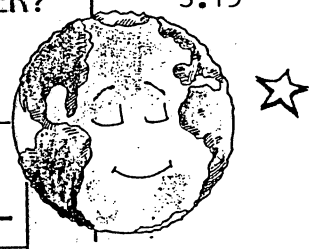
7. **What happens to some of the wastewater from fighting fires and watering yards and crops?**
   (The water sinks into the ground where it is stored.)

8. **What happens to the water or anything else that goes down the drains in our homes?**
   (It goes to the Wastewater Treatment Plant where it is cleaned.)

9. **Some of the water from the Wastewater Treatment Plant is *reclaimed*, which means it can be reused. What do you think it is used for?**
   (Reclaimed water is mainly used to water parks and golf courses. It can be used for most purposes except drinking and cooking.)



WHAT MAKES WASTEWATER?



Directions: Each time you do one of these water use activities in the next 24 hours, put a check in the box next to that activity.

✓

✓		
	Took a bath. 20 gallons x _____ (number of ✓) =	_____
	Took a 5 minute shower. 20 gallons x _____ (number of ✓) =	_____
	Washed my hands. 2 gallons x _____ (number of ✓) =	_____
	Flushed the toilet. 5 gallons x _____ (number of ✓) =	_____
	Brushed my teeth. 1 gallon x _____ (number of ✓) =	_____
	Ran the dishwasher. 15 gallons x _____ (number of ✓) =	_____
	Washed dishes in full sink. 5 gallons x _____ (number of ✓) =	_____
	Washed clothes in machine. 40 gallons x _____ (number of ✓) =	_____
	Washed the car. 100 gallons x _____ (number of ✓) =	_____

Other Uses:

_____

_____

_____

TOTAL GALLONS OF WASTEWATER

Little Jack Horner

Little Jack Horner
Sat in the corner,
Watching his father change oil,
He knew with some pain
If it went down the drain
The fish in the creek it would spoil.

Litle Jack Horner
Sat in the corner,
He suggested the fireplace instead,
His father said no,
The oil's dangerous so,
It might combust into lead.

Little Jack Horner
Sat in the corner,
"The garbage instead we could use!"
Sharp as a beagle
His dad said, "Not legal!"
"Our garbage service we could lose!"

Little Jack Horner
Sat in the corner,
Couldn't they bury it in dirt?
His father replied:
"Soil critters can't hide,
And many of them would be hurt."

Little Jack Horner
Sat in the corner,
Remembering his good friend Michael,
Who once had said
From his father's shed
Some substances they did recycle.

From ***SLEUTH,1982***

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THE FOLLOWING ARE THREE ACTIVITIES ABOUT OIL AND ITS EFFECT ON THE ENVIRONMENT.

ALASKA OIL SPILL

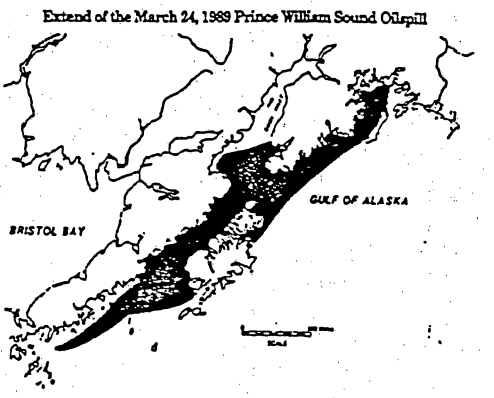
by Bill Noomah and Belle Mickelson

DURATION: four sessions:
the first, 15 - 25 mins.,
the second, 60 - 90 mins.,
the third and fourth, 45 - 60 mins.

OBJECTIVES: Students will develop an experiential knowledge of having to respond to a simulated environmental disaster, and will reflect on the technological and political responses to an oil spill emergency.

BACKGROUND: A major oil spill like that of the *Exxon Valdez* can take a devastating toll on wildlife. Sea birds are attracted to oil slicks and will try to dive and feed in them, hopelessly oiling their feathers. When oil gets on the fur of seals, sea lions and sea otters, it means a loss of insulation. In the great baleen whales, oil clogs the hairs that filter plankton out of the water, thus impairing their feeding. Eggs and young of many species of fish and shellfish are harmed by extremely small concentrations of oil (as low as 1 to 10 parts per billion!). Larger-but-still-small concentrations (10 to 100 parts per billion) can cause reduced feeding or reproduction in adult fish. And as the spill moves onshore, intertidal organisms, as well as shore birds, are affected.

Mechanical clean-up methods include skimmers and booms, suctioning up the oil, or using buckets to skim it up like some of the fishermen did very successfully. Dispersants (detergents or sand) make the oil sink - but not disappear. Oftentimes, the dispersants combine with the oil to form even more dangerous hydrocarbons. Another technique favored by Exxon is the use of Corexit, a kerosene derivative. Other scientists worry



MATERIALS:
- ☐ News clippings
- ☐ 5 1/2 gallon plastic milk containers
- ☐ Aluminum foil/styrofoam
- ☐ Wire/popsicle sticks
- ☐ Detergent
- ☐ String
- ☐ Oil absorbant material
- ☐ Cotton balls
- ☐ Construction paper
- ☐ Wax paper/plastic wrap
- ☐ Scissors/tape/paper clips
- ☐ Eyedropper
- ☐ Sand/gravel
- ☐ Seaweed or pondweed
- ☐ Yard debris containing sticks and leaves
- ☐ Bird feathers
- ☐ Used motor oil
- ☐ Refrigerated salt water (enough to fill tubs)
- ☐ Pencils/Protractor

Worksheet:
- ☐ Ocean Oil Pollution

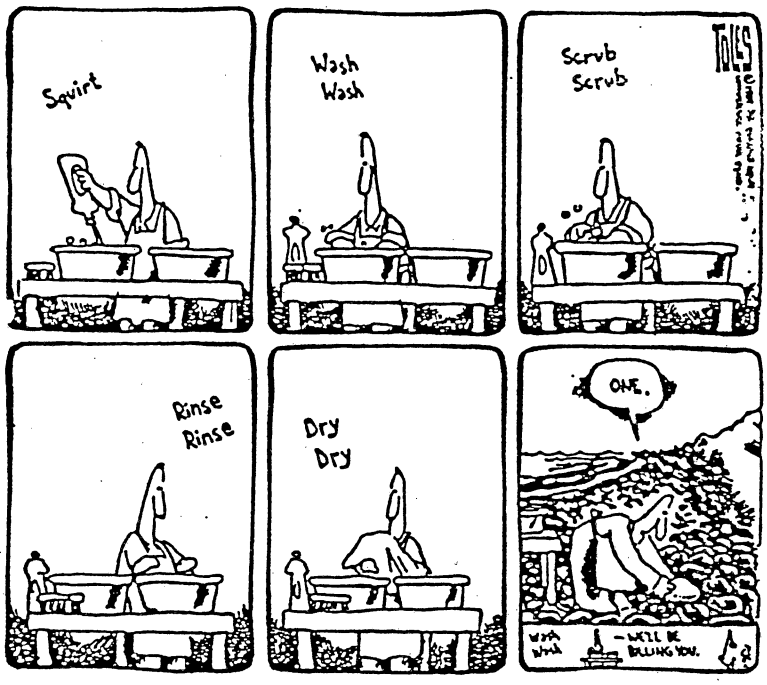
that Corexit may have very harmful effects on wildlife and fisheries.

The pressurized hot water beach clean-up techniques were quite controversial - because, although it took the oil off the rocks, it drove some of the oil deeper into the substrata only to gradually leak out again. Some experts felt, however, that by breaking up the oil it kept pavement from forming on the beach. Some of the citizen clean-up programs initiated oiled seaweed pick-up on the beaches. The seaweed was a natural oil collector and the more that was picked up, the less oil that spread around to other bays and estuaries. Bioremediation, the use of fertilizer to increase the populations of oil eating bacteria was another technique that was tried. Also a rock washing program was developed where rocks were cleaned by tying them up in specially designed bags - so the ocean's tidal action could wash them. And oil absorbant pads were used to wipe off rocks individually.

At the end of this activity, students will have a chance to investigate other sources of oil pollution. Even though large spills are the most spectacular and heart rendering, it is actually the day-to-day operations of oil tankers and daily life in coastal and river communities that do the most damage.

EDITORIALS

Eugene, Oregon, Sunday, April 16, 1989



An Oil Spill in the Classroom

Materials (per group of 2-4)
1 clear bowl or plastic cup
water
vegetable oil
Dish washing detergent
Paper towel
small piece of cloth
sponge
string
feather or Q- tip
paper towels
baby powder
plastic spoon

Directions
1.) Fill your cup or bowl half way full of water
2.) Pour a capful of vegetable oil into your water

What happened?_____
_____

3.) Add more oil if you do not have enough to make a thin layer covering the entire surface of your water.
4.) Gently shake the bowl/cup to make waves like the ocean.

Did the oil and water mix?_____

5.) While creating small waves dip the feather(or Q-tip) into the water.

If this was Papa when he was diving into the water to catch krill for his new chick, what happened?_____
_____

6.) Take a paper towel and try to wipe the oil off of Papa's feather(or the Q-Tip).

Did it work? _____

What did the scientists have to use to clean Papa's feathers?
_____

What do you think we could use to clean the oil off of our feather/Q-Tip?
_____

7.) Sprinkle some baby powder onto your feather/Q-Tip .

Does this help absorb some of the oil? Explain what happened_____
_____
_____

What are some other way you might try to clean the oil off of the feather?_____
_____

8.) How could the scientists clean up the oil they spilled? Let investigate.

Take the string and make a border around the oil while shaking the bowl.
What happened?_____
_____

Try to clean the oil with the detergent.
What happened?_____
_____

Try to clean the oil with the small piece of cloth.
What Happened?_____
_____

Can you blow the oil apart? Explain what happens_____
_____

Try to scoop the oil out with a spoon. What Happens?_____
_____

Try to clean the oil with the sponge?
What happened? _____
_____

9.) Write a paragraph explaining what you learned about oil spills from this experiment._____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

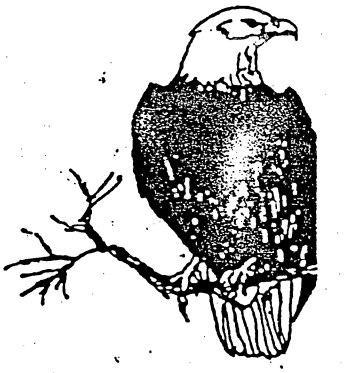
CRITTER CLEAN-UP 3.23

Adapted from: Sea World Education, used with permission.

SUBJECT: Science

DURATION: 1 period

OBJECTIVES: Students will identify ways oil spills can affect wildlife adversely. Students will demonstrate a variety of ways humans can remove oil from birds' feathers and animal fur, hair and leather.



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

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

MATERIALS:

- ☐ Feathers
- ☐ Leather
- ☐ Fur
- ☐ ~~Heavy weight motor oil~~ Syrup
- ☐ Funnel
- ☐ Five large bowls
- ☐ Water
- ☐ Three types of detergent: a mild hand soap, a powdered laundry detergent, and a grease-cutting dishwashing detergent
- ☐ Paper
- ☐ Pencil
- ☐ Cooking Oil
- ☐ Shallow containers
- ☐ 4 hard boiled eggs
- ☐ Newspapers
- ☐ Oil absorbant pads
- ☐ "The Trauma of Being Cleaned"

Oil spills are just one example of the kinds of pollutants that can have adverse short and long-term effects on wildlife, people and the environment. The impact of DDT on food chains is well-known. DDT's influence on thinner

egg shells in bald eagles and other birds is well documented, one more in a combination of factors which contribute to threatening, endangering, and eliminating species.

PROCEDURE:

1. Before class, fill the five bowls with water. In the first bowl pour a slick of oil on the surface. Leave the second bowl as just plain water. Label the other three bowls #1-3. Dissolve a tablespoon or two of one of the detergents in each bowl. Do not let the students see which solution is in which bowl. (They are secret or mystery solutions).

2. WARN THE STUDENTS THAT OIL IS A TOXIC SUBSTANCE NOT TO BE TOUCHED OR BREATHED. Put enough oil in a small container to submerge three hard-boiled eggs. Take another egg and roll briefly in the oil and then leave it on a newspaper for 30 minutes. Put the eggs under a good light and watch closely. Remove one egg after five minutes and examine it — before, during and after peeling off the shell. Try to remove the excess oil from the outside before attempting to peel the egg. Remove the second egg after 15 minutes and the third egg after 30 minutes, repeating the procedure, examining each carefully. Compare the results to the fourth egg which was merely dipped in the oil. Discuss observations. What effect could oil have on the eggs of birds nesting near the water?

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

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

5. Reveal the names of the detergents and show the students the containers they were in. Which detergent was the most effective? The Bird and Otter Rescue Centers in Alaska used Dawn Detergent. How do their results compare with yours? Explain that detergents are like dispersants. They make the oil disappear, but the hydrocarbons in a natural ecosystem would still be in the water column and would end up in the sediments.

6. POUR YOUR REMAINING OIL BACK IN ITS ORIGINAL CONTAINER USING A FUNNEL. SAVE YOUR OIL AND WATER MIXTURES FOR THE NEXT ACTIV-

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

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

8. Discuss how people try to save birds caught in oil spills. Does handling birds cause problems? (stress) Could detergents be harmful to the birds? What ingredients are listed on the package? Are they safe for animals? Marine birds need waterproof feathers. Would their feathers be waterproof after cleaning? Answer these same questions for other animals.

9. To evaluate students understanding have them answer these questions in their journals:
   a. How could an oil spill affect the success of birds nesting near the water?
   b. Describe some possible effects of oil on a feather.
   c. Explain why the effects of oil are different from those of water.
   d. Describe some possible negative effects of three other human-caused pollutants on people, wildlife and the environment.

EXTENSIONS:

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

2. Science/language arts. Ask each student to write a report, summarizing the findings of the experiment as well as making recommendations. Refer to the Wildlife Rescue activity on page 59 of this curriculum.

THE ALASKA OIL SPILL GAME 3.24

by John Stark, for Project WILD

DURATION: three 40 minute periods

OBJECTIVES: Students will be able to describe the general events of the March 1989 *Exxon Valdez* oil spill in Prince William Sound, Alaska. Students will draw a mural of PWS. Students will play a game simulating conditions for cleaning up a maritime oil spill. Students will discuss the feelings of workers in the Alaskan clean-up effort. Students will identify energy conservation ideas.

BACKGROUND: On March 24, 1989 the oil tanker *Exxon Valdez* ran aground on Bligh Island in Prince William Sound and spilled 11 million gallons of crude oil into the water. The oil had been piped through the Trans-Alaska oil pipeline from Prudhoe Bay on the north coast of Alaska and was bound for oil refineries in Washington's Puget Sound.

The clean-up effort was made especially difficult by the remoteness of the area, the lack of road access, the ruggedness of the beaches and the sheer size of the fouled area. Over 1000 miles of coastline were covered with oil, an area that would reach from North Carolina to Massachusetts or from northern to southern California.

Authorities in charge of handling such an oil spill emergency were unprepared for a spill of this size. Cleaning techniques were controversial and included hot water high pressure washing, dispersants, bioremediation, cold water washing, Corexit (a kerosene derivative), wiping individual rocks with absorbant pads, picking up oil with pompoms, picking up oiled seaweed, using mechanical skimmers to concentrate the oil and suction hose to pick up the oil, booming off sensitive areas (salmon streams and hatcheries) and as some of the fishermen did very successfully — just scooping up oil with buckets! Then there was the problem of what to do with the oil, oil and water mixtures, oily wastes and oily clothes.

MATERIALS:

- ☐ Newsprint
- ☐ Crayons
- ☐ Colored magic markers
- ☐ Tempera paint (include the color black)
- ☐ Globe
- ☐ State map of Alaska
- ☐ Paper
- ☐ Pencils
- ☐ 100-150 plastic balls or other small objects
- ☐ Red and blue ribbon or flagging tape
- ☐ Pictures of Prince William Sound (see bibliography)

d. While workers collect tar ba[illegible]he squall(s) chases them. If he/she can steal the red ribbon from a cleanup worker or [illegible]ve ribbons from a boat, the worker or the boat has been caught by a squall on the Sound and must return to "port" to wait out the storm.

e. While cleanup workers are collecting tar balls the dump supervisor(s) throws some of them back onto the water and beach to symbolize the vastness of the volume of oil spilled.

f. As the game progresses and the bad weather of September approaches, more students are assigned as squalls, and clean-up efforts become more difficult and dangerous. Finally, in September weather conditions are so bad and the Sound so full of squalls that all clean-up efforts must be suspended until the following spring. The game portion of the game ends.

6. Teacher leads a discussion based on the following questions:
What emotion did you feel when you saw how big the beach and the spill are?
What emotions did you experience when the waves washed the oil back out into the water?
How do you think a real oil spill clean-up employee would feel seeing the dead and oiled animals on the beach and floating in the water?
Do you think it will be possible for the workers to restore the Sound to the way it was before the spill? Why? Why not?
Oil from Prudhoe Bay is shipped through Prince William Sound and other areas in order to supply some of our energy needs. Can you say that your own family's use of oil products is the partial cause of this oil spill? If so, why is this true?
Are you willing to change your own energy use habits in order to make such spills less likely? If so, what kinds of changes would you make?

7. At this point the teacher may invite the students to write letters to express what they would say to clean-up workers to express thanks for their hard work and to encourage them in the clean-up effort. Letters may be written to the President or to congressmen or other officials expressing concern over the spill. Students may explore ways to encourage energy conservation in their own families and in their community.

EXTENSIONS:

1. Social studies/language arts/mathematics: Students may decide to have a car wash, bake sale or other activity to raise money to assist in the clean-up effort. Check the list of Organizational Resources at the back of the curriculum for organizations involved with oil spill clean-up that need your help.

2. Social Studies: Students may identify other environmental disasters or potential disasters in their area. They may find ways to help out in those situations by writing letters, raising public awareness, or raising money.

STUDENT PAGE

READER THEATER: CIRCLES ON THE EARTH

Here's a script for you and your friends to perform. You can make it as simple or elaborate as you like. Five of you can read this aloud in class. Or your entire class can participate—with four or five of you reading each part together—for a performance on stage. Let your imagination soar as you add dances, songs, scenery, costumes, even dramatic lighting.

Reader 1: At this moment, the earth, our home, is spinning through space.

Reader 2: Rotating on its axis at 1,000 miles per hour.

Reader 3: Revolving around the sun at 65,000 miles per hour.

Reader 4: As it travels through space, the earth gives us the things we need to survive:

Reader 1: Air and water...

Reader 3: Soil and sunlight...

Reader 4: Food and warmth.

Reader 5: And the earth will always give us the things we need to survive, if we remember this:

Reader 2: The earth moves in circles.

Reader 3: The earth moves in circles.

All: The earth moves in circles.

Reader 1: Air is a circle. We breathe oxygen—

Reader 4: And breathe out carbon dioxide.

Reader 5: Plants take in that carbon dioxide, use it to make food...

Reader 4: And breathe out oxygen.

Reader 2: Air is a cycle, a circle, that flows from the animals...

Reader 3: To the plants...

Reader 2: And back again.

All: The earth moves in circles.

Reader 3: Water is a circle, too. Water rains down on the land...

Reader 5: Moves through rivers, lakes, streams, and oceans...

Reader 3: And evaporates back up into the sky, only to rain down once again.

Reader 1: Water is a cycle, a circle, that flows from the sky...

Reader 4: To the land...

Reader 1: And back again.

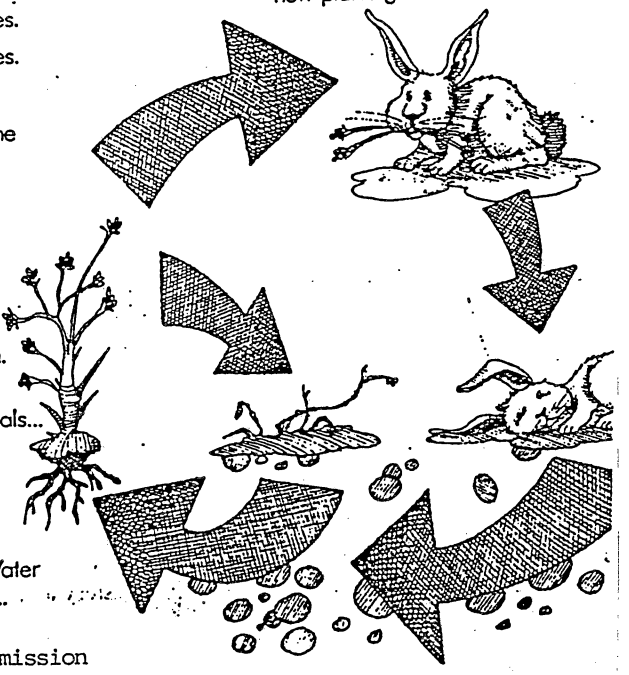
All: The earth moves in circles.

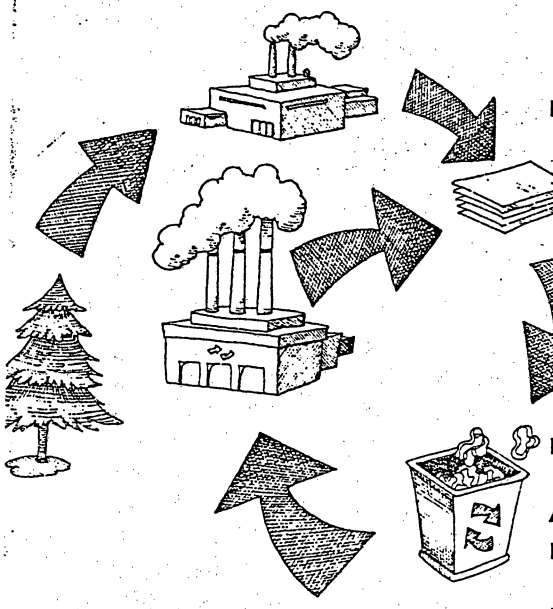
Reader 2: Even soil is a circle.

Reader 5: Plants grow from the soil, die, and decompose...

Reader 2: Decay...

Reader 5: To become new soil from which new plants grow.





Reader 4: The atoms in our bodies come into us from our food.

Reader 3: Our food got those atoms from the soil.

Reader 2: So we are from the soil.

Reader 1: And when we die, we decompose...

Reader 2: Decay...

Reader 5: To become new soil from which new animals grow.

Reader 1: So soil is a cycle, a circle, the circle of life...

Reader 2: And death.

All: The earth moves in circles.

Reader 3: But people didn't understand this law, and now we have some problems with the environment.

Reader 4: Problems that arose because, unlike the earth...

All: People move in straight lines.

Reader 1: They make something, use it once, then throw it out.

Readers 1 and 2: They make it, use it once, throw it out.

Readers 3 and 4: They make it, use it once, throw it out.

All: They make it, use it once, throw it out.

Reader 5: They throw away diapers and light bulbs...

Reader 2: Rubber tires and TVs...

Reader 4: Cars and cameras.

All: They make it, use it once, throw it out.

Reader 1 *(Pause first):* What happens when they run out?

Reader 3: Run out of materials to make new things from?

Reader 5: Run out of places to throw things away?

All: What happens when we run out?

Reader 2: The solution might be that people should work in circles, too...

Reader 4: Just like the earth.

Reader 1: Then they'd make it, use it...

Reader 3: Recycle and reuse it.

Reader 2: Make it, use it...

Reader 5: Recycle and reuse it.

Reader 1: Make new paper from old, new bottles from old.

Reader 2: Reuse metal, and glass, and rubber in cars.

Reader 5: Make things that last...

Reader 3: And are not thrown away.

Reader 4: Because there's no "away" anymore.

Reader 1: Make it...

Readers 1 and 2: Use it...

Readers 1, 2, and 3: Recycle...

All: And reuse it.

Reader 5: And live in the circles of the earth.

Reader 4: Dance in the circles of the earth.

Reader 3: Play in the circles of the earth.

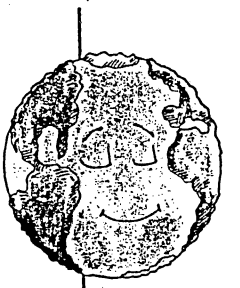
Reader 2: Celebrate the circles of the earth.

All: Know the circles of the earth.

Reader 1 *(very slowly):* The circles of the earth.

FAMILY ACTIVITY SHEET

3.26



Did you know...

A family of 4, on average, throws out more than 100 pounds of trash of week? And sends 2,500 gallons of wastewater down the drain?

Multiply those numbers by the millions of families in this country and you can see we have a gigantic amount of solid and liquid waste to dispose of.

Your child is helping...

The *Think Earth* Environmental Education Program has been teaching your child about waste in the environment—how much we produce, what we do with it, what problems it creates, and how we can help solve those problems. In *Think Earth* units at other grade levels, children are also learning to conserve natural resources, reduce waste, and minimize pollution.

Children at all grade levels are learning that their habits and behaviors can have an impact on the environment—for better or worse.

You can help too...

Your family can support your child and help the environment in many ways. First, go over your child's self-survey on the back of this sheet, discussing what your child already does and what else he or she can do to help the environment. Then as a family, plan ways that you can do the following:

Reduce the amount of trash you produce,

for example:

- ☐ Buy products with less packaging.
- ☐ Use returnable and refillable containers.
- ☐ Use fewer disposable products.
- ☐ Other: _____

Reuse whatever you can,

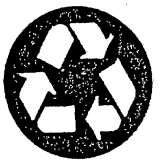
for example:

- ☐ Give used items to charity.
- ☐ Repair broken appliances.
- ☐ Save boxes and plastic containers to reuse.
- ☐ Other: _____

Recycle whatever you can,

for example:

- ☐ Save newspapers, metal cans glass and plastic bottles.
- ☐ Put yard clippings into a compost pile.
- ☐ Take used motor oil to an oil recycling center.
- ☐ Other: _____



Avoid hazardous products whenever possible,

for example:

- ☐ Use water-based instead of oil-based paints.
- ☐ Use vinegar and water instead of ammonia cleaners.
- ☐ Use non-toxic pet shampoos.
- ☐ Other: _____

Conserve water,

for example:

- ☐ Wash only full loads in dishwashers and clothes washers.
- ☐ Install low-flow shower heads.
- ☐ Use a bucket of water rather than a running hose to wash the car.
- ☐ Other: _____

FAMILY ACTIVITY SHEET

THINK EARTH

Environmental Education Program

★Waste Reduction Unit

NAME: _____

DATE: _____

SELF SURVEY

		I do this now	I'll plan to do this
1	I use only the paper towels, tissues, and napkins I really need.	☐	☐
2	I turn the water off while I'm brushing my teeth.	☐	☐
3	I use a reusable bag or backpack instead of a throwaway paper or plastic bag.	☐	☐
4	I use cloth towels and sponges to clean up instead of paper towels.	☐	☐
5	I drink from washable glasses or cups at home rather than disposable ones.	☐	☐
6	I give outgrown clothes and used toys or books to others to use.	☐	☐
7	I save cans, glass, newspapers, and plastic bottles for recycling.	☐	☐
8	I turn off lights, TVs, and other electrical appliances when I'm not using them.	☐	☐
9	I take short showers or shallow baths.	☐	☐
10	I make sure that my trash ends up in the trash can and not on the ground.	☐	☐
11	I make sure hazardous wastes—batteries, household cleaners, oil, paint—are not put in the trash, down the drain, or into storm drains.	☐	☐
12	I look for products with the least packaging when I buy things.	☐	☐

Earth Day Unit Post-assessment 3.27

Read the sentence. Check always, sometimes or never.

	Always	Sometimes	Never
1. I carry my lunch in a throw-away bag.			
2. I take short showers.			
3. I recycle leftover oil.			
4. I throw away old clothes and toys I don't need.			
5. I use recycled paper.			
6. I save and recycle all aluminum cans.			
7. I put on a sweater if I'm cold.			
8. I turn the water off when brushing my teeth.			
9. I use cloth towels to dry my hands.			
10. I walk when I can instead of riding in a car.			
11. I use one side of a piece of paper.			
12. I drop trash on the ground.			
13. I use a bucket to wash the car.			
14. I keep cold water in the refrigerator.			
15. I leave on lights so the room seems bright.			
16. I buy things with big, bright packaging.			
17. I leave ants and bugs alone or squash them if I need to kill them.			

Earth Day Unit Post-assessment Key 3.27

Read the sentence. Check always, sometimes or never.

	Always	Sometimes	Never
1. I carry my lunch in a throw-away bag.			X
2. I take short showers.	X		
3. I recycle leftover oil.	X		
4. I throw away old clothes and toys I don't need.			X
5. I use recycled paper.	X		
6. I save and recycle all aluminum cans.	X		
7. I put on a sweater if I'm cold.	X		
8. I turn the water off when brushing my teeth.	X		
9. I use cloth towels to dry my hands.	X		
10. I walk when I can instead of riding in a car.	X		
11. I use one side of a piece of paper.			X
12. I drop trash on the ground.			X
13. I use a bucket to wash the car.	X		
14. I keep cold water in the refrigerator.	X		
15. I leave on lights so the room seems bright.			
16. I buy without thinking about packaging.			X
17. I never spray ants or bugs. I leave them alone.	X		

DIRECTIONS: Mark the circle in front of the correct word in each sentence.

1. ○ we ● We should not waste water.
2. Solar energy comes from the ○ sun. ● Sun.
3. Picking up litter will help keep ○ amerca ● America clean.
4. The "don't pollute" owl is named ● Muddy. ○ Wuddy.
5. Hydro power comes from ● water. ○ Water.
6. We are trying to keep ○ california ● California green.
7. Littering is one way we pollute the ○ earth. ● Earth.
8. The ● dinosaur ○ Dinosaur is an extinct animal.
9. A volcano in our state is ● Mt. Lassen. ○ Mt. lassen.
10. Smog is a kind of ● air ○ Air pollution.
11. Not wasting paper is ● school ○ School help. to save our trees.
12. ○ i ● I on not a litterbug.

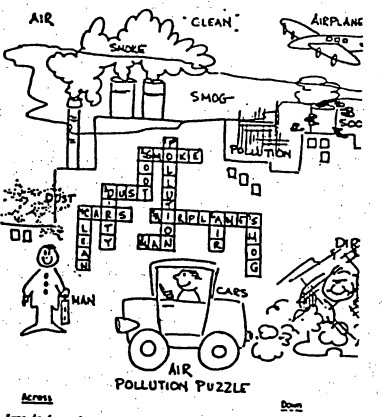
DIRECTIONS

Read the sentences. Add ing to the underlined words and fill in the blanks. Don't forget to drop the silent e.

Example: come coming

1. Since cars cause air pollution, car pooling is better than drive driving alone.
2. Letting the faucets drip is waste wasting water.
3. Throwing trash out your car window is cause causing pollution of the earth.
4. Use Using paper cups is more wasteful than drinking from cups that can be washed and used many times.
5. Smoke Smoking chimneys from factories pollute the air.
6. Smog in the air is damage damaging to plants and animals.
7. Dumping sewage into lakes and rivers is make making them polluted.
8. Take Taking old newspapers to a recycling center helps save trees.
9. Oil spilled in the ocean is pollute polluting the water and killing birds and fish.
10. Using too much paper and plastic in package packaging the things we buy causes pollution of the earth.

RIDING



POLLUTION PUZZLE

Across

2. Smog is fog and _____.
3. Powdered dirt is _____.
4. Exhaust from _____ adds dirt to the air.
5. Exhaust from _____ also adds dirt to the air.
8. Only _____ can help clean up the air.

Down

1. Dirty air is call
2. Ashes are sometim called _____
3. Polluted air is _
4. Air without pollu is _____
6. We need _____ t
7. Smoke mixed with

DIRECTIONS: Read each story. Choose the best title and draw a line under it.

Water is our most important natural resource. All plants and animals need water to live. Man could not live more than 4 or 5 days without water.

Our Natural Resources
Plants and Animals are Alike
Water is Important

Most of our water today is used for growing plants and animals for food. In our homes we use water to drink, cook our food and to bathe. We also use water for fun when we swim, go fishing or boating.

Uses of Water
Swimming is Fun
Cool, Clear Water

We use the same water over and over. The sun evaporates the water from the lakes and oceans. The water vapor forms clouds. When the clouds get heavy, it rains. The rain runs into rivers and streams and back to the oceans. Then the water cycle begins again.

How Clouds are Made
The Water Cycle
Rainy Weather

Everyone should be careful not to waste water. We should remember not to let the water run needlessly. Don't pollute the water by putting things down the drain that will not dissolve easily. We need to keep our water clean and use it wisely.

Living Without Water
Taking Care of Our Water
Our Polluted Rivers

DIRECTIONS: Read the problems. Write the numerals on the blank spaces.

1. Carole and Judy are saving cans for recycling. They each have 8 ca saved so far. How many do they have together?

8 + 8 = 16 cans

2. Tom, Dick and Harry are saving cans too. They have each saved 9 ca How many do they have all together?

9 x 3 = 27 cans

3. Six girls in the third grade each saved 7 stacks of newspapers. Ho many stacks of newspapers do they have in all?

6 x 7 = 42 stacks of newspapers

4. Bob and Betty saved 4 boxes of glass bottles. Each box had 8 bottl in it. How many bottles did they have all together?

4 x 8 = 32 bottles

5. Jim and Mary were saving bottles too. They had 5 boxes of bottles. Each of their boxes had 7 bottles in it. How many bottles did Jim Mary have?

5 x 7 = 35 bottles

6. If Bob and Betty put their bottles together with Mary and Jim's, how many will they have in all?

32
35
67

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APPENDIX B
Greening Your Classroom

Greening Your Classroom

It is not difficult to adopt simple habits in your classroom to demonstrate on a daily basis the commitment of you and your students to a cleaner environment. Try some of the following ideas.

Use old **cloth** hand **towels** instead of paper towels. I request them from parents at the beginning of the year. Clean are kept in a bag under the sink. There is also a bag there for the dirty towels. When the dirty bag is full I take it home to wash. That is about once a week, unless we have had particularly messy activities. Any student may put up a clean towel if the previous one is soiled. We've had no problem with spreading illness, and I have had no complaints from parents.

Use **plastic** plates, dinnerware and cups for parties. Take them home and wash in the dishwasher. (Hard plastic "disposable" brands clean up in the dishwasher.) An alternative is to allow students to each have their own cup that they rinse after each use, if you have the storage room.

Have a class **yard sale** to raise money for field trips and promote reusing and recycling. Tell parents at the beginning of the year to save their things. In October I have a class yard sale. I find a parent volunteer to have it at their house. Students may bring things to school that I will transport, or they may bring things to the sale the night before. Students paint posters to hang the week before the sale. Advertise in the newspaper saying, "Students earning money for field trips." Students are encouraged to help price the items and to come to work at the sale. I have found most parents very receptive to this and everyone can participate to earn field trip money. We usually earn between $150 and $300 in our one-day event.

Encourage the students to bring in anything they no longer want to donate to the class. Use trinkets for weekly class raffles and keep bigger items for class auctions held three times a year. (I have a ticket system in place on my classroom that the students use to "buy" with.)

Collect recyclables to earn money for the class.

Keep a bag of rags for use with watercolor painting. Wash these as a separate laundry load after each use to save on paper.

Always use both sides of every paper. Print all worksheets on "used" paper. Encourage students to bring in paper from home that is clean on one side. Many parents can send paper from their offices. Again I have had no parental objections to this. Have a box in your classroom for paper that is clean on one side. Place papers into the box neatly, clean side up.

Practice not being wasteful. Tell students from the beginning of the year that they only get one sheet of paper for an art project, so plan before cutting.

Make note pads of smaller sized used paper by stapling small piles together. Encourage students to always use these sheets when a full sheet is not required.

APPENDIX C
Annotated Bibliography of Literature Selections

Annotated Bibliography of Literature Selections
(In order of use in the unit)

Use throughout the unit:

The Earthworks Group. (1990). *50 Simple Things Kids Can Do To Save the Earth*
Earthworks Universal Press Syndicated Co.
Intermediate, Middle
Non-fiction
Written in a manner children can read on their own, this book gives simple ideas for children to use to practice Earth-saving habits.

Paulsen, Gary. (1987). *The River*
Bradbury Press
Intermediate, Middle
Fiction
In this sequel to the Newbery Honor Book, Hatchet, Brian, a young teen is asked to again return to the wilderness where he had earlier survived on his own. In this story he finds himself battling a river for his own and his friend's survival.

Kudlinski, Kathleen. (1988). *Rachel Carson: Pioneer of Ecology*
Puffin Books
Intermediate
Biography
Rachel Carson's pioneer book, *Silent Spring,* revealed the dangers of pesticide use. She was a scientist and writer who helped people change the way they look at the Earth.

Week 1:

Lowery, Linda. (1991). *Earth Day*
Carolrhoda Books, Inc.
Intermediate
Non-fiction
The history behind the first Earth Day is presented in an easy to read style. Solutions to problems are also presented.

Scovel, Karen & Ted Hunter. (1993). *Joe's Earthday Birthday*
Earth Friendly Press
Intermediate
Fiction/Picture book
This story shows how Joe can have fun on his birthday without creating a pile of trash by using only things that are recyclable.

Maurer, Richard. (1989). *Junk in Space*
Simon & Schuster, Inc.
Intermediate
Non-fiction
This book explores the garbage we are leaving in space. It is fairly technical, but highly interesting to peruse or for the motivated student to read.

Van Allsburg, Chris. (1990). *Just a Dream*
Scholastic
Primary and intermediate
Picture book/Modern fantasy
Walter's friend gets a tree for her birthday, which he thinks is stupid. Recycling seems a waste of his time. Then Walter falls asleep and dreams of the future which changes his view to the environment.

Hadingham, Evan & Janet. (1990). *Garbage! Where It Comes From, Where It Goes*
Simon & Schuster, Inc.
Intermediate
Non-fiction
This book is packed full of facts and pictures showing the impact of garbage on our environment. Ideas for how everyone can help to make a cleaner planet are included.

Jeffers, Susan. (1991). *Brother Eagle, Sister Sky*
Dial Books
All levels
Historical Fiction
This transcript of Chief Seattle's message about the oneness of all living creatures is beautifully illustrated.

Root, Phyllis. (1992). *The Old Red Rocking Chair*
Arcade Publishing (Out of print but may be available in children's bookstores.)
Primary, Intermediate
Picture book
A rocking chair is reused over and over as people retrieve it from one another's garbage to serve a new purpose for themselves.

Schwartz, David. (1985). *How Much is a Million?*
Scholastic
Intermediate
Picture book
This book uses concepts that are simple to help children understand huge numbers.

Week 2:

Peet, Bill. (1986). *Wump World*
Houghton Mifflin
Primary, Intermediate
Picture book
The Wumps are displaced from their home as the Pollutians invade. The Wumps go into hiding underground until the Pollutians finally leave their world due to polluting it. Finally the Wumps return and slowly their home begins to revert to how it had been, but it will never be just the same.

Church, David. (1992). *Larue and the Brown Sky*
Kresser/Craig Advertising (Available at the public library.)
Primary and intermediate
Poetry/Modern Fantasy
Larue and his friends are sickened by their polluted air a so they begin an effort to clean it up with the help of grandpa who tells them things were not always this way. They battle "Smog" in particular, though once vanquished, Smog threatens he'll be back.

Week 3:

McRae, Rodney. (1991). *Cry Me a River*
Angus & Robertson
Intermediate
Picture book/Modern Fantasy
This is a moving story of water's journey from mountain snow to the sea, as a little boy asks the mountain to cry him a river. The book asks the reader to seek solutions.

Cherry, Lynne. (1992). *A River Ran Wild*
Harcourt Brace Jovanovich
All
Historical non-fiction
The life cycle of the Nashua River, from people's first experience with it as Native Americans settled along its shores, through history, pollution, and finally reclamation to its natural state, is chronicled in this superb book. There are beautiful, large pictures and borders of smaller detailed pictures around the text.

Cole, Joanna. (1986). *The Magic School Bus at the Waterworks*
Scholastic, Inc.
Non-fiction/Fantasy
This book in the collection of Magic School Bus books presents facts about water in a child-pleasing manner.

Glimerveen, Ulco. (1989). *A Tale of Antarctica*
Scholastic
Primary and intermediate
Picture book
This is a story of penguins in Antarctica as they encounter trash and oil spills in their environment left by humans.

Seuss, Dr. (1971). *The Lorax*
Random House
All
Picture book/Poetry
The Lorax' land is destroyed due to the destruction of the Truffula Tree. We can help to save the Lorax.

Seuss, Dr. (1958). *The Cat in the Hat Comes Back*
Random House
Primary
Modern Fantasy/Poetry
As two children try to clean up they discover a pink ring in the tub. No matter what they try to do, this "pollution" spreads.

APPENDIX D
Curriculum Guides

Curriculum Guides
Order Information

Lessons were used with permission from the following:

Alaska Oil Spill Curriculum
Prince William Sound Science Center
Box 705
Cordova, AK 99574
(907) 424-5800

A-Way with Waste
Washington State Dept. of Ecology
3190 160th Ave. S.E.
Bellevue, WA 98008-5452

Conservation for Children
Cupertino Union School District
John Muir Elementary School
6560 Hanover Drive
San Jose, CA 95129
(408) 252-5265

Earth Day 1990 Lesson Plans
Earth Day 2000
116 New Montgomery St. Suite 530
San Francisco, CA 94105-3607

Fred the Fish Lesson
National Science Teachers Association
1742 Connecticut Ave. N.W.
Washington, D.C. 20009-1171

Let's Reduce and Recycle: Curriculum for Solid Waste Awareness -
OSW Publications - Office of Solid Waste - Attn: Curriculum
U.S. Environmental Protection Agency
401 M Street SW
Washington, D.C. 20460

Naturescope Pollution: Problems and Solutions
National Wildlife Federation
1400 16th Street, N.W.
Washington, D.C. 20036-2266

No Waste Anthology
Melinda J. Fox, Public Education Coordinator
California Dept. of Health Services
P.O. Box 942732
Sacramento, CA 94234-7320

Project Wild
5432 Grosvenor Lane
Bethesda, MD 20814
(301) 493-5447

Think Earth
Education Development Specialist
5505 East Carson Street, Suite 250
Lakewood, CA 90713-3093

Waste Wise
The Aseptic Packaging Council
1000 Potomac Street, N.W. Suite 401
Washington, D.C. 20007

Where the Sidewalk Ends by Shel Silverstein
Harper + Row, Publishers
10 E. 53rd Street
New York, NY 10022

APPENDIX E
Video and Audio Selections

Video and Audio Selections

Think Earth. "e" ($25. Available from Educational Development Specialists, 5505 East Carson Street, Suite 250, Lakewood, CA 90713-3093)

This video has two parts. In the first part problems facing the environment are presented through a computer. In the second part children discuss possible solutions. Emphasis is on reducing, reusing, and recycling.

The Rotten Truth ($19.95 including teacher's guide. Available from Sunburst Multimedia Materials for Education, 101 Castleton Street, P.O. Box 100, Pleasantville, NY 10570-0100. 1-800-321-7511)

In the U.S. we generate millions of tons of garbage every year. This video covers many aspects of solid waste problems facing people today. Students are taken on a tour of the "Museum of Modern garbage" by an entertaining child/host. Also included are the world's largest landfill, a garbage magician, and what happens to things taken for recycling.

Down the Drain ($19.95 including teacher's guide. Available from Sunburst Multimedia Materials for Education, 101 Castleton Street, P.O. Box 100, Pleasantville, NY 10570-0100. 1-800-321-7511)

The water cycle and what happens to water that gets dirty is shown in this video. How to clean water, how to conserve water and how to preserve water are included in a child-appealing format.

Bottom of the Barrel ($19.95 including teacher's guide. Available from Sunburst Multimedia Materials for Education, 101 Castleton Street, P.O. Box 100, Pleasantville, NY 10570-0100. 1-800-321-7511)

Oil has many uses and pollution problems. This interesting video covers oil from getting it out of the ground to cleaning it up after it is spilled.

Banana Slug String Band - Environmental songs (Order form follows.)
Tapes and song books
BSSB, P.O. Box 2262, Santa Cruz, CA 95063

Hot Mud - Environmental songs
P.O. Box 2708, Wrightwood, CA 92397 (818) 398-8962

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Buethe, C. & Smallwood, J. (1987). Teachers' environmental literacy: check and recheck 1975 & 1985. Journal of Environmental Education, 18(3), 39-42.

California Department of Education. (1992). It's Elementary! California Department of Education. Sacramento, CA:Author.

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