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The Environment Around Me

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As Vice President, Al Gore, suggests in " *Earth in the Balance/Ecology and the Human Spirit* ", the Earth still remains more or less in balance. Whether that balance can be maintained and the health of our planet improved depends, to a large extent, on how well we communicate our conservation message and motivate others to act.

Some people think the levels of carbon monoxide in our atmosphere are too high. They are afraid Earth's temperature will rise, making it unhealthy for life. Health specialists say that carbon monoxide reduces the blood's ability to deliver oxygen to vital tissues, affecting primarily the cardiovascular and nervous systems. Lower concentrations have been shown to adversely affect individuals with heart disease and to decrease maximal exercise performance in young people. Higher concentrations above the national standards can cause symptoms such as dizziness, headaches, and fatigue.

Carbon monoxide is an odorless and colorless gas produced by incomplete burning of carbon-based fuels, including gasoline, oil and wood. Carbon monoxide is also produced from incomplete combustion of many natural and synthetic (man-made) products. For instance, cigarette smoke contains carbon monoxide. Automobiles, buses, trucks, small engines, and some industrial processes produce carbon monoxide. High concentrations can be found in confined spaces like parking garages, poorly ventilated tunnels, or along roadsides during periods of heavy traffic.

Lead is a metal that occurs naturally in soil, rocks , water, and food. Normally, only a small fraction of the lead we are exposed to comes from breathing air that contains lead. Most lead to which humans are exposed is ingested in food. However, because lead particles in air are so small, as much as 50% of the lead that is inhaled is retained in the body.

Lead is a hazardous substance. Elevated levels above the national standard can adversely affect psychological development and performance, kidney function, and blood chemistry. Young children are particularly at risk due to increased sensitivity of young tissues and organs.

The primary sources of lead in Connecticut and the United States have been emissions form lead smelters, battery plants, and automobiles burning gasoline with lead additives. Transportation sources alone historically contributed about 80% of the annual emissions on a national basis.

When it was determined that lead levels in the United States were too high and might contriute to heablth

problems, environmental agencies took steps to eliminate lead poisoning and pollution. For instance, now we use unleaded gasoline or alternative fuels in our automobiles. Gasoline with added lead can no longer be purchased as an automotive fuel in the United States. This has had an effect in Connecticut.

In order to measure metals like lead in air, dust and other pollutants' particles are collectd on filter peaper for 24 hours. The filter paper is then analyzed in a laboratory to see what metals it contains. The State of Connecticut Department of Environmental Protection Air Monitoring Section samples lead to identify areas of the state where lead levels might be too high.

Lead levels exceeded the acceptable levels established by the U.S. Environmental Protection Agency in the 1990's and early 1980's. Lead levels have exceeded the standard even more recently. The National Ambient Air Quality Standards for lead require that the average lead concentration at a site not exceed 1.5 micrograms per cubic meter during any calendar quarter.

Most of today's students consider themselves environmentalists because they want to pass on a clean, green legacy to their descendants. Most of them know that conserving our natural resources and preserving what is left of our natural world make sense ethically and economically. Protecting our air, land and water not only helps to safeguard all life, it creates and sustains more jobs than it eliminates. Protecting our natural heritage is not only good for wildlife and campers, it is good for our economy as well.

My hope is that *The Environment Around Me* will become an invaluable aid for motivating students. It will provide clear guidelines and procedures for involving these students in significant learning experiences in research and high level thinking skills, while not neglecting challenging learning experiences within the basic disciplines of mathematics, science, reading, and writing. The approach is one that engages the interests of students at a deep level.

Students will learn how to carry out research and will develop independent learning skills through the program of studies presented in *The Environment Around Me* . Success in independent study and research, as well as effective use of libraries and other information resources is not simply the product of trial-and error activity in school. It is the are product of teacher guidance and stimulation, along with instructional materials and methods and of an overall system which provides the requisite skills and develops the appropriate attitudes.

Yet, our earth continues to be stressed by growing numbers of people consuming a limited amount of resources. In this country, a small but exceedingly powerful lobby of real estate, grazing, mining, logging, off-road vehicle, and other high-impact interests demands carte blanche to do as they please with the nation's diminishing resources. These well-organized forces pretend to represent balance and moderation. They portray themselves as defenders of our Constitution, as champions of our property rights, as advocates for the people-aligned against the special interests of elitist environmental groups. All too often, they succeed in projecting this false image.

How can they get away with it? Quite simply, they succeed in selling their misleading message because they are sharply focused and highly motivated and because they have access to the best communications talent that money can buy.

Meanwhile, student environmentalists have not been nearly as savvy about communicating our message. Time after time students have failed to get the word out, often with tragic results. The cause of environmental protection is as American as baseball, yet we frequently end up not playing baseball.

The student's opponents have the power of many and all of the high-priced expertise and political influence that comes with it. But the students have something even more powerful - the power of people, a growing number of people who care about the future of our land and our communities. With better communication skills, students can mobilize this support for whatever it is students are determined to save, improve, restore, and sustain.

This curriculum does not presume to suggest what the students environmental message should be. What do students say about air, soil, and water pollution? What you will find in this curriculum are the fundamental principles that will enable students to convey their message more effectively.

This curriculum presents students with a variety of research problems that each student will attempt to solve. Students will use writing skills to solve problems that are developmentally appropriate. Students will acquire the skills used to examine data and to process ways of analyzing the data in order to write about it. Consequently, writing and problem-solving abilities of the students will improve as they practice multiple approaches (newsletter/brochure) to the problem.

Students will experience writing using the scientific method, solving problems to the best of their ability, and analyzing old and new information. They will receive a variety of guided explanations and demonstrations on problem-solving, along with reviewing basic language skills. They will learn to monitor their own progress.

Students will work in cooperative groups as cooperative groups play an important role in school and outside of school. Students will interact and work in small groups throughout each of the activities. Team building and cooperation are important skills that students will need in todays world. For some students, working with others will be a new experience. The expected outcome is the development of the skills needed for collaboration, such as respect for others ideas.

As students are working in groups, sharing and listening to others becomes the key to successful mathematical/ scientific decision-making. Each student has a role in the group, such as recorder or materials manager, so that they become responsible for their own learning. Students assume new roles as they change activities so that each group member has an opportunity to fill each role. The teacher's role will be that of facilitator. This task includes listening and effective questioning to help students stay on, or get themselves back on, track.

As students interpret data, discuss and support approaches to problems, read blueprints, write reports, defend solutions, and draw conclusions, the levels of proficiency among students will vary . To foster participation and effective communication by all students, therefore, the teacher must try to obtain an assessment of the students' communication skills. This can be accomplished by listening to the students as they talk about and interpret the problem at hand. Who is having difficulties understanding the requirements? Which students cannot identify and explain the components and objectives of the activity?

Overall, *The Environment Around Me* is a curriculum designed to promote research. Research is sometimes not given enough emphasis in learning activities. Yet, as students get older, many teachers require the use of research skills for project work. Research skills are to a motivated learner what batting and catching skills are to a gifted baseball player — the means to an end. How else is a ballplayer to play? How else is a student to learn? This curriculum utilizes basic skills, the fundamentals that make it possible to be an independent learner.

In this rapidly changing world, students need to have the ability to think critically, solve problems, make

decisions and communicate their ideas to others. One purpose of *The Environment Around Me* is to assess students' ability to apply these skills in a realistic manner within an interdisciplinary context. This curriculum will help students develop skills tested in the CAPT Mathematics, and Interdisciplinary Assessment.

In the Interdisciplinary Assessment students use knowledge and skills they have gained through their social studies, science, mathematics, language arts and other classes. Students are presented with several resources (e.g., newspaper or magazine articles, government documents, editorials, political cartoons, maps, charts or graphs) related to a significant issue. Students begin with a brief group discussion. The purpose of this collaborative activity is to give students the opportunity to begin thinking about the topic and to share their ideas with others before starting the task.

Students work independently for the remainder of the interdisciplinary task. They are asked to read the source materials to gain information about the topic and to consider various perspectives on the issue. Students are provided with graphic organizers and scratch paper for notes.

Students are then asked to use the information they have gained from their readings, as well as their prior knowledge, to take a position on the issue. They prepare a writing draft stating and supporting their position, using information from the source materials. For example, students may be asked to draft a letter to their congressperson, or to prepare an editorial for a newspaper attempting to persuade the audience to adopt a particular position.

Environmental science comprises those disciplines that consider the physical, chemical, and biological aspects of the environment. Like the earth and life sciences, it transcends disciplinary boundaries and is concerned with the interactions among processes-each of which is best described by a particular discipline. It is the study of natural cycles, systems, and their components.

Environmentalism and environmental science are distinct. The former is a popular movement with political, social, and philosophical implications. The latter provides a means for obtaining precise information about the environment, in order to better understand it. The two connect, and many environmental scientists are as concerned about damage to the environment as campaigning environmentalists.

Environmental science embraces all those disciplines which are concerned with the physical, chemical, and biological surroundings in which organisms live. Environmental science draws heavily on aspects of the living organisms, life and earth sciences, but there is some unavoidable overlapping in all of these groupings.

Any study of the earth and the life it supports must deal with process and change. The earth and life sciences also deal with process and change, but environmental science is especially concerned with changes wrought by human activities, and their immediate and long-term implication for the welfare of living organisms, including humans.

Environmental science acquires political overtones and leads to controversy. If it suggests that a particular activity is harmful, then modification of the activity may require national legislation. Almost certainly, there will be an economic price that not everyone will have to pay or pay equally. We may all be environmental winners in the long term, but in the short term, there will be financial losers and, not surprisingly, they will complain.

Over the last thirty years or so, we have grown anxious about the condition of the natural environment and increasingly determined to minimize avoidable damage to it. In most countries, there is now a legal

requirement for those who propose any major development project to calculate its environmental consequences, and the resulting environmental impact. This assessment is taken into account when deciding whether to permit work to proceed.

Certain activities are forbidden on environmental grounds, by granting protection to particular areas, although such protection is rarely absolute. It follows that people engaged in the construction, extraction, manufacturing, power-generating or power-distributing, agricultural, forestry, or distributive industries are increasingly expected to predict and take responsibility for the environmental effects of their activities. They should have at least a general understanding of environmental science and its application. For this reason, many courses in planning and industrial management now include an environmental science component.

The study of the environment requires a working knowledge of words and terms that may be unfamiliar to students. *The Environment Around Me* introduces vocabulary terms only when they are essential to the key concept or principle in each activity. Activities generally have between four and ten new terms. In this way, students are introduced to important terms and develop a working environmental vocabulary.

Each term can be introduced before the activity under some heading. The terms can be phonetically respelled and defined. Within the activities, the environmental terms can be boldfaced, or underlined, phonetically respelled and defined in context. Students are thus provided with a preview of terms.

Recognizing the importance of vocabulary skills development is important. Vocabulary skills, such as using prefixes, suffixes, and root words; identifying word origins and so on, are reinforced in *The Environment Around Me* . Exercises also stress word relationships and applying definitions.

The emphasis on environmental process skills and their relationship to mathematics and scientific methods has become an integral part of environmental teaching pedagogy. The implementation of mathematics and science process skills and methods is a unique and important feature of *The Environment Around Me* .

Writing is important to all academic disciplines. Writing involves a number of skills, including the ability to collect information, to analyze information, and to organize the information. Writing involves formulating ideas and sequencing relationships, drafting, ordering, articulating paragraphs, and polishing written materials to reach a final draft.

The Environment Around Me enhances writing competence by correlating writing activities to the scientific activities. In this way, reading and writing complement each other. Challenge features, such as research skills and information search encourage students to read and write about various topics. Research skills also stress the application of science, mathematics and scientific skills and processes, while providing students with practice that combines reading, writing, and communication information to another person in a clear, concise way.

The Environment Around Me! can be used in many ways. The lessons and the overall design of the curriculum lead to a variety of applications, such as basic skill activities, full-class units or courses, small-group lessons, independent study, and even curriculum development. Regardless of how *The Environment Around Me* is to be implemented, it is important to understand its organization and recognize what it provides. Like a good cookbook, this curriculum supplies more than a list of ingredients. It offers suggestions, advice, and hints; provides organization and structure; and gives time lines, handouts, and materials lists. In other words, it supplies everything necessary for you to conduct the projects.

The Environment Around Me was produced with the teacher in mind. Every research project is divided into three general sections to provide uniformity throughout the curriculum and to give each component a standard placement in the material. The first section, “Teacher Preview”, gives a brief overview of the scope and focus of the research project. The second section, “Lesson Plans and Notes”, outlines a detailed, description. After reading this, every nuance of the project should be understood. The third section, Instructional Materials, supplies the “nuts-and-bolts” of the project -reproducible assignment sheets, instructional handouts, test, answer sheets, and evaluations.

Teacher Preview

The Teacher Preview is a quick explanation of what a project accomplishes or teaches. It is divided into seven areas, each of which provides specific information about the project:

Length of Project: The length of each project is given in classroom hour. It does not take into account homework or teacher-preparation time.

Level of Independence: Each project is identified as “basic,” “intermediate,” or “advanced” in terms of how much independence is required of students. The level of independence is based primarily on how many decisions a student must make and the level of responsibility required. It is suggested that students who have not acquired independent learning skills, regardless of their grade level.

For teachers who are interested, there is a correlation between the skills development mentioned here and the progression to higher-level thinking skills typified by Benjamin Bloom’s “Taxonomy of Educational Objectives”:

Level of Independence	Bloom’s Taxonomy
Basic	Knowledge
	Comprehension
Intermediate	Application
	Analysis
Advanced	Synthesis
	Evaluation

Goals: ***These are straightforward statements of what a project is designed to accomplish. Goals that recur throughout the series deal with skill development, independent learning, and “kids teaching kids.”***

During This Project Students Will : This is a list of concise project objectives. Occasionally, some of these statements become activities rather than objectives, but they are included because they help specify what students will do during the course of a project.

Skills: Each project emphasizes a specific set of skills, which are listed in this section. Further information about the skills is provided in the “Skills Chart.” You may change the skill emphasis of a project according to curricular demands or the needs of the students.

Handouts Provided: The handouts provided with a project are listed by name. This includes assignment

sheets, informational handouts, tests, and evaluation forms.

Project Calendar: This is a chart that graphically shows each hour of instruction. Since it does not necessarily represent consecutive days, lines are provided for you to pencil in dates. The calendar offers a synopsis of each hour's activity and also brief notes to clue you about things that must be done:

PREPARATION REQUIRED	STUDENTS TURN IN WORK
NEED SPECIAL MATERIALS	RETURN STUDENT WORK
HANDOUT PROVIDED	ANSWER SHEET PROVIDED

Lesson Plans and Notes

The lesson plan is a detailed, hour-by-hour, description of a project explaining its organization and presentation methods. Projects can be shortened by reducing the time spent on such things as topic selection, research, and presentation; however, this necessitates de-emphasizing skills that make real independent study possible. Alternately, a project may require additional hours if students are weak in particular skill areas or if certain concepts are not thoroughly understood.

Each hour's lesson plan is accompanied by notes about the project. Some notes are fairly extensive if they are needed to clarify subject matter or describe a process.

Instructional Material

There are five types of reproducible instructional materials included in *The Environment Around Me* Most projects can be run successfully with just a student assignment sheet; the rest of the materials are to be used as aids at your discretion.

Student Assignment Sheets: Virtually every project has an assignment sheet that explains the project and outlines requirements.

Additional Handouts: Some projects offer other handouts to supply basic information or provide a place to record answers or research data.

Tests and Quizzes: Test and quizzes are included with projects that present specific content. Since most projects are individualized, the activities themselves are designed to test student comprehension and skill development.

Evaluation Sheets: Many projects provide their own evaluation sheets. In addition, the Teacher's Introduction to the Student Research Guide (see the Appendix) contains evaluations for note cards, posters, and oral presentation. Some projects also supply self-evaluation forms so that students can evaluate their own work.

Forms, Charts, Lists: These aids are provided throughout the series. They are designed for specific situations in individual projects.

The Brochure

A brochure is a printed piece that pictures and describes your cause. Your brochure can range from a simple

leaflet printed on both sides to an elaborate twelve-panel presentation.

Ten Steps to a Successful Brochure

1. Decide what you want to say, and then say it as clearly and concisely as you can. After you do a first draft, go back over the text and narrow it down to about half that size. Then go over it again and eliminate more words.
2. Condense your message into one phrase (the theme) to be used on the cover or as the first words your reader is drawn to inside. State your theme at the outset, and let the text and graphics flow from there.
3. Tell your story in a logical, narrative sequence - and do not be afraid to tug at your reader's heart strings or "to appeal to your reader's emotions".
4. Use graphics that illustrate, inform, enliven, and tell most of your story in a glance.
5. Use pictures with emotional impact- pictures that will move your reader- and play the pictures big.
6. Use pictures with sufficient contrast to reproduce well.
7. Stress graphics over text. Be generous with the size of your pictures and the amount of blank space. (Blank space is not wasted space.) Be bold with your headlines . Devote at least two thirds of your brochure to pictures, heading, blank space, and other visual enhancements.
8. Choose a lettering that is big enough and dark enough to be read easily. Strive for sharp contrast by using dark ink on a light background. Keep in mind that white letters on a dark background can dramatically highlight a cover message or principal headline inside.
9. Consider using a second color to accentuate headings, backgrounds, and graphic features.
10. Collect brochures and other printed material that appeal to you, and adapt useful ideas and techniques to your own communications.

RESEARCH

Many teachers require the use of research skills for project work. Research skills are to a motivated learner what dribbling and passing skills are to gifted basketball player - the means to an end. How else is a student to learn? This curriculum emphasizes basic skills, the fundamentals that make it possible to be an independent learner.

Research is the key to most individualized learning. Given students who have been taught to find and use information independently, a teacher has the luxury to spend time and energy providing a classroom setting where students can, in fact, learn on their own. Remove that "given" and the teacher's role becomes one of "information provider", rather than "learning facilitator". This curriculum was not produced to provide independent study projects for students; rather, it was designed to teach students how to become independent learners. The process of teaching students to use research skills requires a dedicated teacher who understands that a product is always preceded by a process. In this case, the ability to conduct a research project must be preceded by the acquisition of skills, which is what this curriculum is all about.

The Environment Around Me curriculum is based upon skill development. The activities are arranged according to the amount of independence required, and a list of skills is provided for every activity in this curriculum. Many of them are basic common sense skills that are already being taught in your classes.

The skills are divided into seven general skills areas: research, writing, planning, problem solving, self-discipline, self-evaluation, and presentation. Examination of skills quickly shows which skills are important to an activity and which ones may be of secondary value. An activity may be changed or rearranged to redirect its skill requirements. The activities in this curriculum are designed to teach the use of skills. If an activity lists twenty skills, but you want to emphasize only five or six of them, this is a perfectly legitimate use of the activity.

Evaluating students on their mastery of skills often involves subjective judgments; each student should be evaluated according to his or her improvement rather than by comparison with other students. Activities will have evaluation forms to help with this process. In addition, the "Teacher's Introduction to the Student" provides evaluation for notecards, posters, and oral presentation.

CHOOSING A SUBJECT

The first step in any research project is choosing something to study. This requires some thought and decision making. The hand-out provides several guidelines that will help you select a subject.

1. Choose a subject in which you are already interested or about which you would like to find more information.
2. Choose a subject that will meet the needs or requirements as outlined by the teacher:
    a. Listen for suggestions from the teacher
    b. Be alert to ideas that come from class discussion
    c. Talk to friends and parents about things you can study and learn
3. Choose a subject you can understand, not one in which you will become "bogged down," lost or disinterested
4. The encyclopedia should serve as a tool for choosing the right subject and narrowing it down to a focused area.
    a. It gives the general areas of the subject
    b. It identifies specific topics related to your subject
    c. It is written simply enough to understand without hours of study.
5. Before you commit yourself to a subject, check to make sure there is enough information

available. There is nothing more frustrating than starting a report that cannot be finished because there aren't enough books, magazines, filmstrips, newspapers, journals, experts or even libraries that have enough information.
6. Once you have chosen a subject, write down a series of questions to which you want to find answers. These questions will help direct your research.

Research Project

Teacher Preview

Time of Each Project:	4 to 52 weeks
Grade:	4 -12
Research Categories:	Air Pollution
	Soil Pollution
	Water Pollution
General Explanation:	These research projects are vitally identical in structure, with each offering a different subject area to study while requiring the use of a basic set of research and presentation skills. It is suggested that only one, or at most, two of them be used with a group of students in any given school year, to avoid repetition and potential boredom.
Goals:	1: To require the use of research skills as students learn about specific topics.

2. To emphasize independent learning.

3. To promote the concept of "students teaching students."

During this project students will: 1. Define and select topics for research. 2. Combine the research skills they have mastered into one individualized project. 3. Assemble information for a report. 4. Present what they have learned to the rest of the class. 5. Discuss and analyze the project upon its completion. Skills:

Preparing bibliographies	Persistence
Collecting data	Sentences
Making notecards	Sense of quality
Summarizing	Creating presentation strategies
Writing	Drawing and sketching
Meeting deadlines	Self-confidence
Accepting responsibility	Teaching other
Personal motivation	Public speaking

Handouts Provided:

"Students Introduction to the Research Project"
"Students Assignment Sheet" for each area of study Teacher's Introduction to the Student Research Guide

a. Notecard Evaluation
b. Poster Evaluation
c. Oral Presentation Evaluation

Student Research Guide

a. Choosing a subject
b. Where to go of write for information
c. Project fact sheet
d. Brochure sheet
e. Develop checklist to use prior to presentation

PROJECT CALENDAR:

LESSON 1 _____ Discussion of the general requirements of a research project.

Students are given their project assignment sheets.

LESSON 2:_____ (Optional): Discussion of checklists and evaluation forms from the Student research Guide.

LESSON 3:_____ Students study in class from encyclopedias. Topic lists are begun.

LESSON 4:_____ Students study in class from encyclopedias.

Topic lists and final choices are turned in.

LESSON 5:_____ Final topic choices are returned with teacher approval.

Students conduct research.

LESSON 6:_____ Students conduct research.

LESSON 7:_____ Students conduct research.

LESSON 8:_____ Students conduct research.

(Optional): Collect notecards and bibliographies at the end of the hour for a brief check.

LESSON 9:_____ Students begin working on posters and written reports.

LESSON 10:_____ Students work on posters and reports.

LESSON 11:_____ Work on posters and reports continues

LESSON 12:_____ Students complete their work on posters and reports.

LESSON 13:_____ Students begin making presentations to the class.

LESSON 14:_____ Presentations to the class continue.

LESSON 15:_____ Finish presentation.

LESSON 16:_____ Discuss about the skills used in this project:

Why they could be used to study other things.

LESSON 17:_____ LESSON 18:_____

1. Give students the handout that introduces them to the general requirements of a research project. Most of the hour is discussion about what research is used for and why it is important for a person to be able to find information, record it, put it into some kind of order, and present it to others. Point out that many careers require people to use these research skills and that certain skills are necessary regardless of what is being studied. Give students their assignment sheets during the last fifteen minutes of the hour and briefly discuss the requirements.. The entire project will be explained during 3 hours.
2: Spend the first part of the lesson discussing the assignment handout and answering student questions. For the rest of the time, each student studies encyclopedias and other general references to begin compiling a list of topics that could be used for a research project. This list is to be completed by the end of the next class.
3: Students continue to work on their topic lists by studying encyclopedias. When a list is completed, the student identifies which topic he or she intends to pursue for the remainder of the project. These lists and final topic selections are handed in at the end of the class. Each assignment sheet calls for students to make lists of topics that they would like to study; these lists are to be handed in. The reason for this requirement is to allow you some control over topic selection, primarily to help students avoid the trap of choosing topics that are too difficult, exotic, or obscure
4: Students have their final topic selections returned with your approval. If you consider a topic to be inappropriate, tell the student to meet with you and select another topic from his or her list. Students who receive approval begin their research projects, using sources that are available in the room or that they have provided themselves. For successful completion of these projects it is very important that many resources be available to students, either in a library or in the classroom.
5: Research continues. At the end of three classes, student may be required to hand in notecards and bibliography cards for a brief check before beginning work on posters and written reports.
6: Students work on posters and written reports. Materials for poster making need to be available for at least four hours: pasteboard, markers, rulers, colored pencils, drawing paper, scissors, glue/paste, and whatever other tools and materials are needed. Establish some method for cleaning up each hour, such as assigning student aides each day to run a simple checkout system. Many students are not accustomed to picking up after themselves or may not think it matters. Taking care of materials, however, is an important self-discipline skill and should be strongly emphasized.
7: Students present their projects to the class as oral reports. They are graded for presentation skills as well as project content. Posters are displayed in the classroom and written reports are handed in.
8: The final class is provided to help students see the ultimate value of the project they have just completed. Discuss the skills that are necessary for conducting a research project, producing a brochure, and making an oral report. Ask students if they have a different perspective from what they had during the first class discussion when research was discussed in general terms. Spend time explaining how students who have gone through the experience of a research project such as this are prepared to tackle projects that allow even more independence. Ask students to name

some things they feel confident they could learn about if given an opportunity. This helps reinforce the idea that what was learned from the project can be applied to many other learning situations.

RESEARCH PROJECT: INTRODUCTION

Learning on your own requires a great deal of independence and self-motivation. Choosing a topic to study, finding information relating to it, and then presenting what you have learned to others involves many skills. You are being given the responsibility of doing a research project because you already possess many basic research skills and because the experience of learning on your own teaches things a teacher cannot provide in a lecture.

Keep in mind that the topic you will be studying will develop skills that will help you a great deal in future courses and possibly your career as well.

You will gain experience in the following areas:

1. Finding sources of information about a topic you choose to study.
2. Making notecards and bibliography cards while doing research.
3. Organizing the information form notecards into a written report
4. Creating an interesting way to teach the rest of the class about your topic.
5. Designing a visual display that is eye-catching, informative and complementary to your oral presentation.
6. Working from an outline to complete the requirements
7. Meeting deadlines and timely disciplining yourself to pace your work.
8. Managing your study time to derive the maximum benefit from efficient use of this time.
9. Solving problems as they arise and changing plans as needed.
10. Presenting your work to others in the form of a brochures or newsletters.

The specific requirements of your research project are outlined on a separate handout so that you can see the entire plan and organize your work accordingly. Once you are able to complete an assignment like this on your own, it is logical that you could choose almost any topic and go about studying it. All subjects cannot be taught in school, but this shouldn't keep you from learning about those that are of special interest to you. Apply the skills presented in the project and learn on your own.

Student Assignment Sheet

The subject of this research project is environment pollution. You will select a pollution to study, identify one specific cause, and conduct a research project about that topic.

After a pollution is selected, follow this assignment outline to complete the project:

1. Study the pollution (in encyclopedias and other general references) and identify at least three topics that you would be interested in investigating further. This list of topics will be handed in.
2. From this list choose one topic that you want to study.
3. Use a variety of sources (at least five) for your research. No more than three of these can be encyclopedias.
4. Carefully and accurately record a minimum of ten facts about the topic on notecards.
5. Make a bibliography card for each source.
6. Write a three-to-four-page report after using your notecards to organize an outline. Writing skills will be carefully graded on this report.
7. Make a presentation to the class about your topic. Design an interesting brochure for this presentation that includes your ten facts and any other information you want to show visually.
8. At the conclusion of your presentation turn in these things:
    A. Written report (three to four pages)
    B. Ten notecards
    C. Five bibliography cards (or a bibliography sheet)
    D. Brochure

Lead Information

The data shows the sites that had the highest quarterly lead average from the years 1983 through 1995. Data

is given for New Haven and Bridgeport. The quarterly average is given because that is the value regulated in the national standard. The first quarter of the year is January through March, the second quarter is April through June, the third is July through September and the fourth is October through December. The highest quarterly average is the highest of the four quarters.

Activity

1. Using the "New Haven Data" plot the highest quarterly lead averages for New Haven from 1983 through 1995. These can be found in the last column of the data file. Plot years along the X-axis and micrograms per cubic meters along the Y-axis. From the data given, locate the highest quarterly average for each of the years 1983 through 1995 to see the trend.
2. Using the "Bridgeport Data", create the same plot for data collected in Bridgeport.

Highest lead averages/year quarter

Measurements in micrograms per cubic meter

Year	City	
	New Haven	Bridgeport
1983	0.37	4.9
1984	1.48	6.66
1985	2.01	4.31
1986	1.41	1.58
1987	1.38	1.38
1988	0.87	0.39
1989	1.76	0.42
1990	1.61	0.42
1991	1.11	0.46
1992	0.91	0.26
1993	0.99	0.23
1994	0.58	0.14
1995	0.69	0.19

Carbon Monoxide

The data shows the eight-hour average concentration standard has been exceeded occasionally in Bridgeport, New Haven, and Stamford during 1975 through 1995, during the months when very stable atmospheric conditions exist.

Activity

The data contains the highest measurements of carbon monoxide taken each year for the past twenty one years in Bridgeport, New Haven, and Stamford areas. The EPA eight-hour standard is 9 parts per million. Students can plot the carbon monoxide measurements on the Y-axis and the years on the X-axis to show how

carbon monoxide levels have changed from year to year in these areas and compare the levels in each city. Students also can mark the standard of 9 parts per million with a dotted line and compare the measured levels to the standard. Students can write report, comparing the cities' measurements taken over the 21-year period to the standard.

Carbon monoxide in three Connecticut cities

Measurements in part per million

Year	City		
	Bridgeport	New Haven	Stamford
1975	8.3	7.8	8.5
1976	4.7	4.2	7.5
1977	4.7	5.4	12.2
1978	5.8	7.6	8.1
1979	5.9	4.6	9.9
1980	5.4	4.6	11.1
1981	6.4	5.1	9.3
1982	6.6	5.1	14.6
1983	6.3	6.0	11.1
1984	6.1	5.1	11.3
1985	6.4	5.0	11.8
1986	6.7	5.6	10.3
1987	6.1	5.6	15.3
1988	5.3	5.5	11.3
1989	4.1	6.0	10.8
1990	5.6	4.7	13.9
1991	5.3	3.5	9.7
1992	6.7	4.2	9.4
1993	7.4	5.1	7.4
1994	7.4	4.3	9.9
1995	6.9	4.5	15

SAMPLE GRAPH

Carbon Monoxide

	1975	1976	1977	1978
Bridgeport	8.3	4.7	4.7	5.8
New Haven	7.8	4.2	5.4	7.6
Stamford	8.5	7.5	12.2	8.1

(figure available in print form)

Lead Information

	1983	1984	1985	1986

Bridgeport	4.9	6.66	4.31	1.58
New Haven	0.37	1.48	2.01	1.41

(figure available in print form)

Monitoring Station

1. Students will conduct weekly experiments, on the same day each week, to determine the air quality, soil quality, and water quality of a given area.

The class will select 5 sites to be studied at these monitoring stations and compare the monthly average of each.

At the end of the study, the students will report their findings to the department of environmental protection.

2. Students may want to start a central data-collection location on the Internet where data from students in other cities can be shared and compared.

Soil Testing

What is a PH value? The designation “pH” is an abbreviation for “power of hydrogen.” This refers to the content of acid or, to be more precise, “acid ions” (hydrogen ions H+) in the water. Pure water has very, very few acid ions (one tenth of a millionth gram per litter). This water has neither acidic nor alkaline reactions but is neutral. It has the pH value of 7.

When acid e.g. vinegar are added to water, or water absorbs the acids contained in the soil, the number of “acid ions” increase, e.g. one hundred-thousandth gram per litter. This acid water then has pH value 5.

On the other hand, there can also be even less “acid ions” present than in neutral water, e.g. one billionth gram per litter. In this case, the pH value is 9. This water is alkaline.

Equipment and Materials

Small bucket, 2 test tubes, double spoon, cooking salt, measuring beaker, distilled water, bung

plastic funnel, filter paper, pH indicator solution, pH color chart

Activity

Determine the pH value of different kinds of soil: clay soil, sand soil, marsh soil, and woodland soil.

Method

1. Select a certain type of soil and take samples in different places (at a depth of 5-10 cm). Place these individual samples in a small bucket and mix them well.
2. Place approx. 2 cm of the finely crushed, crumbly soil mixture in a test tube, add the large spoon end of the double spoon full of cooking salt and 10 milliliter (measuring beaker) distilled water. Close the test tube with the bung and shake well for one to two minutes.
3. Leave the test tube to stand until most of the soil particles have settled to the bottom.
4. Place the plastic funnel with the folded filter paper on a second test tube. Carefully pour the soil solution through the filter without disturbing the settled particles, and collect the filtered liquid until it is aprox. 2 cm high.
5. Now add 4 drops of pH indicator solution and carefully swirl the test tube. Compare the resulting color with color chart.

Results:

Different pH values will be obtained depending on the kind of soil involved.

For example, clay soils have a pH of 6 - 7.5, sandy soils about pH 5.5 - 6.5. Marsh soil and marsh water is fairly acid, with a pH of 2.5 - 3. Woodland soils is normally slightly acid (pH 5.5).

Water Testing

Activity

Discover the pH value of:

drinking water, rain water, water in rives, and mineral water.

Equipment and materials

Test tube

pH indicator solution

pH color chart

Method

1. Pour the water sample into the test tube to a height of approx. 4 cm.
2. Add 4 drops of pH indicator solution and swirl the test tube. Compare the color with the color chart.

Results

Drinking water usually has pH 7. If drinking water is acidic (pH 5/6), this indicates dissolved carbon dioxide. The same result is obtained for mineral water containing carbon dioxide. If the pH value for rainwater is less than 7, you have found evidence of "acid rain" and the indirect pollution of the air with acid-forming exhaust fumes. Acid water can also be regularly found in marshy river. Weakly alkaline drinking water come from limestone areas. Strongly alkaline water is only to be expected in the case of pollution with soaps or similar detergents.

BIBLIOGRAPH

Artzt, Alice F. and Clair M. Newman: *How to Use Cooperative Learning in the Mathematics Class.* Reston, Virginia: National Council of Teachers of Mathematics, 1990.

Barsukov, V.L. Et al: *Venus Geology, Geochemistry, and Geophysics.* 1992.

Brown, Lester, *Tough Choices:* facing the challenge of food scarcity. New York: W.W. Norton, 1996

Campbell, Todd R. *Dirty Air, Unhealty Childen.* Master Thesis Yale School of Forestry & Environmental Studies, MES' 1997

Colborn, T., D. Dumanoski, and J.P. Myers, *Our Stolen Future* . New York: Dutton, 1996

Coxford, Arthur: The Ideas of Algebra, K-12. *Reston, Virginia: National Council of Teachers of Mathematics, 1988.*

Drantz, Les. *What the Odds Are.* New York: Harper Collins Publishers. 1992.

Dowie, Mark, *Losing Ground:* American environmentalism at the close of the twentieth century. Cambridge, Mass: MIT Press, 1995

Herr, Ted and Ken Johnson: *Problem Solving Strategies: Crossing the River with Dogs.* Martin Luther King Jr. Way, Berkeley, California: Key Curriculum Press. 1994.

Hopkins, Nigel, J. Et al: *Go Figure! The Numbers You Need for Everyday Life.* Detroit: Visible Ink Press. 1992.

Landwhr, James M. and Ann E. Wathings: *Exploring Data.* Palo Alto, California: Dale Seymore Publications. 1986.

Levadi, Barbara et al: *Math A Rich Heritage.* Upper Saddle River, New Jersey: Globe Fearon Educational Publisher. 1995.

UNICEF, *State of the World's Children.* Oxford; New York: Oxford University Press for UNICEF

Vig, N. and M.E. Kraft, *Environmental Policy in the 1990's.* Washington, D.C.: CQ Press, 1997

Wargo, John, *Our Children's Toxic Legacy.* : How science and law fail to protect us from pesticides. New Haven: Yale University Press, 1996

Wildavsky, A., But is It True? *: A citizen's guide to environmental health and safety issues. Cambridge, Mass.: Harvard University Press. 1995*