



*EE Toolbox—
Workshop Resource Manual*

Integrating Environmental Education Into the School Curriculum

*EE Toolbox—
Workshop Resource Manual*

Integrating Environmental Education Into the School Curriculum

Martha C. Monroe
*University of Michigan
Ann Arbor, MI*

David Cappaert
*University of Michigan
Ann Arbor, MI*

This project has been funded by the
United States Environmental Protection
Agency under assistance agreement number
EPA-G-NT901935-01-0 to the University
of Michigan School of Natural Resources
and Environment.

N C E E T

National Consortium for
Environmental Education
and Training

School of Natural
Resources and Environment
University of Michigan
Ann Arbor, MI 48109-1115
313 998-6726

Workshop Resource Manual
Managing Editors:

Martha C. Monroe
David Cappaert

Copy Editor:

Nancy A. Osborn

ISBN 1-884782-04-3

The contents of this document do not necessarily reflect the views and policies of the United States Environmental Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

© Copyright 1994 by the Regents of the University of Michigan

Educators may photocopy these materials for the non-commercial purpose of educational advancement.

Printed on paper containing 50% total recycled fiber/25% post-consumer fiber using soy-based ink.

Designed by Margaret Re
Typeset in Sabon, News Gothic, and Franklin Gothic Number 2.

Contents

Introduction	3
I What to do in a Workshop: Three Strategies	5
A. Providing Resources that Meet Teachers' Curricular Objectives	5
B. Helping Teachers Make The Content Connection	7
C. Integrating EE to Teach Process Skills.	8
II Making Sense of the Mix.	10
III A Bit of Background	11
IV Workshop Activities and Masters: Integration	13
V Resources	54

This unit is for any workshop facilitator who wants to help teachers integrate environmental themes into their teaching. In it, you will find ideas for making connections between environmental content and other disciplines. For workshop facilitators with little or no classroom experience, the unit includes a brief discussion of curricular issues. To help you plan your workshops, we present approaches for a range of audiences, from teachers who need classroom-ready activities to those who want to create new lessons. Overall, this unit emphasizes ways to help teachers think about how to integrate EE into their teaching. While it includes specific examples, it does not focus closely on any particular content area. This will depend on what teachers need and what their districts require.

This unit begins with a rationale for integrating EE into traditional school curricula. It goes on to describe three strategies for exploring integration in workshops. Then, after a brief discussion of two main integration philosophies, this unit ends with 10 activities that you can use or modify for your workshops and a list of resources for both facilitators and teachers. An example of some of the challenges facing teacher educators as they help teachers integrate EE is next.



“AS YOU PUMP FROM THE WELL, what happens to the blue dye we put in the landfill?” Marisa queried the elementary teachers huddled around the groundwater demonstration model.

“Wow!” exclaimed an enthusiastic fifth-grade teacher. “The blue dye traveled half way to the well. And look at the other dyes we put in!”

This teacher workshop on groundwater was typical of most of the others Marisa conducted over the years. The elementary teachers enjoyed the hands-on experience with her model and usually borrowed it when they did groundwater units with their fifth and sixth grade classes. These units often involved an exploration of the water cycle and the ways people influenced water quality.

But when Marisa conducted two groundwater workshops for high school science teachers, the outcome was a bit different. Although they were interested in groundwater and eager to share information with their earth science students, Marisa was surprised at the constraints they faced. They were only able to use the model to enhance a small section of the textbook. Even though their students had the capability to investigate the social consequences of groundwater contamination or any of the many related local issues, the teachers couldn't consider building that type of unit into their curriculum.

When Marisa talked with secondary teachers about how her workshop might encourage a different outcome, the discussion always came back to the state and district science curriculum guidelines. These formal objectives were the basis for student assessment, and all the teachers were committed to using them to guide their lesson plans.

Marisa realized that many of her goals as an environmental educator were similar to formal objectives in social studies and language arts as well as in science. For instance, she wanted students to understand groundwater problems in a political sense and be able to communicate effectively about those issues. Was there a way to get teachers talking about cross-discipline applications for her groundwater models? Should she open her workshop to teachers from a mix of disciplines?

After considering her options, Marisa decided to offer two different workshops for secondary teachers. In one, she continued to offer scientific information and the groundwater model to science teachers. She advertised the other as an exploration of the political, economic, and social consequences of groundwater pollution and referred to social studies objectives that matched her personal environmental goals. If the new workshop was successful, Marisa thought to herself, she would find a way to reach social studies and science teachers in one workshop.

Introduction

ONE OF THE MOST COMMON CONCERNS teachers have when considering environmental education (EE) is that their days are already full. In a 30-hour week, they typically spend eight hours on non-instructional routines, behavior management, and social activity.¹

Most of the remaining time is committed to core disciplines—math, language, social studies, and science. “Extra” time goes to physical education, art, music, health, and life skills. Special activities for multicultural education, esteem-building, or career development are also achieving a place in the curriculum. As important as EE is, teachers tend to see it as just one more thing to squeeze in.

However, EE can become part of the curriculum without stealing time from other subjects. This unit provides some ideas to help teachers address environmental concerns, which can enhance what they already teach.

Some teachers already know they want to use EE techniques and concepts; others may need an introduction. “Defining Environmental Education,” another unit in the *Workshop Resource Manual*, provides a rationale and several workshop activities to introduce teachers to EE. The reasons for teachers to build EE into their classroom activities are numerous:

- Environmental concepts offer an exciting context for the application of scientific principles, math and language skills, and social studies concepts.
- Every community has environmental concerns as well as community resources to aid in exploring those concerns.
- EE teaches skills for problem-solving along with environmental content.
- EE provides a context for exploring student attitudes and values.
- EE often includes outdoor adventures and hands-on activities that effectively engage students with different learning styles.
- EE easily encompasses many of the principles in education reform: multicultural education, real world applications, cooperative learning, empowerment, interdisciplinary topics, etc.

“ We have fragmented the world into bits and pieces called disciplines and sub-disciplines, hermetically sealed from other such disciplines. As a result, after 12 or 16 or 20 years of education, most students graduate without any broad, integrated sense of the unity of things. The consequences for their personhood and for the planet are large.”²

*David Orr
Professor of Environmental Studies
at Oberlin College*

These advantages can make EE very compelling to teachers. However, teachers aren't the only ones to make decisions about curriculum. Even the most motivated teachers can be constrained by traditional school goals, state mandates, and standard assessment tests. Ultimately, broad support is needed to sanction any shift in instructional priorities. School boards can promote EE by setting learning goals and outcomes for environmental awareness. Many states mandate EE and include environmental concepts in assessment exams: Wisconsin requires that new teachers complete EE training for certification in elementary education as well as in secondary science, social studies, and agriculture; Minnesota specifies student outcomes reflecting EE goals and allows districts to decide how those outcomes are achieved. Schools and teachers across the country have also been acknowledged and rewarded for their efforts in bringing about changes in conservation behavior in their communities.

Several examples of how individual teachers effectively teach EE are offered below; greater detail on each can be found on Master 11. The next section offers three different strategies for addressing these different needs in your workshops.

Examples From the Classroom

- A group of home arts teachers in Maryland used a water-conservation project to integrate the environment into their curriculum. After studying water quality and water use, their students learned how to install toilet dams and faucet flow restrictors and offered their services to their parents.
- A sixth-grade teacher in Illinois led students through a similar process of exploring a topic and taking action to resolve an issue. However, she let her students independently choose their own topics, such as animal testing and illegal dumping. For this teacher, integrating environmental concepts into the curriculum means helping students achieve her goals in questioning, researching, critical thinking, evaluating, and decision-making.
- For a third-grade teacher from Wisconsin, integrating EE into her lessons means revisiting the loons she discovered on vacation and weaving them into every subject she teaches: mapping where they live through out their range, measuring the distance between loon-inhabited lakes and major roads, reading Native American stories about loons, and writing stories about other animals that live in loon lakes.
- A secondary chemistry teacher in California used newspaper articles to integrate a study of smog into his course. However, after reading the articles, his students were curious about why outdoor grills would be regulated by new air quality legislation. Building on this curiosity, the class investigated the chemistry of air pollution, using their textbook as a resource and the newspaper as a guide.
- Finally, EE can be integrated into several classes at once with an interdisciplinary, team-teaching approach to education. In North Carolina, students learned about paper production, stream pollution, and toxic waste in their science, social studies, language arts, and math classes. Because official support for EE varies, teachers will express various needs for EE inservice programs.

What To Do in a Workshop: Three Strategies

TEACHERS IN DIFFERENT BUILDINGS and administrators in different districts will want different things from EE. To address these needs, we offer you three general strategies for helping teachers integrate EE into their curricula. For the teachers who want ready-to-go instructional materials, use the first strategy to provide specific activities to match their objectives. If they design their own materials, use the second strategy to help them identify curricular connections and develop their own activities and units. For those who are interested in using environmental projects to develop their students' problem-solving abilities, use the third strategy to help these teachers practice relevant planning and facilitation skills.

A. Providing Resources That Meet Teachers' Curricular Objectives

The simplest way to help teachers see how environmental information and activities can enhance curricula is to show them. Before your workshop, identify a few curriculum objectives that the participants are required to meet. You can do this as part of a needs assessment (see "Designing Effective Workshops" in the *Workshop Resource Manual*) or more casually by calling one or two registered participants. Another method is to obtain published objectives from the school district or state education agency. The next step is to then choose interesting activities that intertwine your environmental perspective with their objectives in science, social studies, geography, art, math, and language arts.

Examples:

- For English composition teachers, distribute several newspaper articles highlighting environmental successes or problems and then discuss questions such as:
 - What is the main idea, and how does the author support it?
 - How many different people or organizations are involved?
 - What else is similar to this story/problem/success?
 - How does the headline focus attention on one aspect of the story?

- Math teachers often seek ways to use real data in their teaching. You might provide information about wildlife or human populations, tell them how you found it, and help them link it to fractions, decimals, ratios, graphs, exponents, formulae, and story problems. You can find good models in existing resource materials such as *Project WILD* (e.g., "I'm Thirsty," "Turkey Trouble," and "Bearly Born") and Zero Population Growth's *USA by Numbers*, both of which are listed in the "Resources" section on page 54.
- Teachers in Tennessee have environmental objectives in science, social studies, and health classes, such as:

"Define the causes of air, water, and land pollution."

"Be aware of the relationship between population size and the quality of life."

"Realize that different lifestyles influence energy demands."

"The facilitator holds your hands and walks you through it. Otherwise, it's one of 35 pounds of handouts at a conference that gets sorted out this summer — maybe."

Michigan science teacher speaking about the advantage of Project WILD

Common Barriers to Integration—How to Handle Them

There are a few predictable challenges you might face as you encourage teachers to integrate environmental concepts into their classes.

“What’s environmental about art?”

Some teachers may not completely understand why they should incorporate environmental information into their classes, particularly in non-science subjects. Use the rationale and activities in the *Workshop Resource Manual* unit “Defining Environmental Education” to explain that environmental problems are complex, interdisciplinary issues, not compartmentalized problems that can be addressed within a single content area. Suggest that they work with teachers of other subjects to address an environmental topic.

“But I don’t know enough.”

Many teachers think they need to understand all the complexities of an environmental issue to be able to conduct related activities. It is true that the more they know, the more confident they will feel and, most likely, the better they will do in the classroom. But uncertainty should not prevent them from getting started. In your workshop, conduct an activity where you don’t have all the answers and demonstrate the process of questioning and exploring together—see Activities 5 and 6 in this unit and activities in the units on “Defining Environmental Education” and “Approaching Environmental Issues in the Classroom.” You can provide background materials and resources, guest speakers, and films to help fill in the content gap; encourage teachers to do the same (try Masters 6, 7, and 8 in the unit on “Using Community Resources” to provide guidelines for speakers and field trips). You can provide case studies and examples of successful teachers who learned about environmental problems right along with their students (see *Getting Started*, also in the EE Toolbox).

“But what can I do tomorrow?”

Matching the workshop format to the participants’ expectations is particularly important—if you conduct a workshop to help folks create their own units when all they want are nifty activities for Monday morning, you and your participants will be frustrated. Assess the group’s



“Develop an appreciation for Earth’s environment and the necessity for keeping it clean.”

Several resources described at the end of this unit provide excellent information and activities that address these objectives: *Project WET*, *Connections*, *Living Lightly in the City*, *For Earth’s Sake*, and *Nature-Scope’s Pollution: Problems and Solutions*.

Many popular curriculum resources, such as those listed above, assist teachers by identifying the curricular objectives met by each unit or activity. You can use the activities in Activity Section A to demonstrate this point. A few activities in other *Workshop Resource Manual* units can also be helpful here—see “Defining Environmental Education” and “Urban Environmental Education.”

As you plan for a workshop based on materials you provide, consider the following points:

- Participants will be most interested in the resources they can use to meet the objectives they must cover. Remember

to plan ahead to learn what they teach and target your materials carefully.

- Participants might not be familiar with these resource materials, local environmental issues, or EE goals and objectives. You may want to begin with some activities from the “Defining Environmental Education” unit in the *Workshop Resource Manual*.
- Participants will be most impressed with classroom-ready activities and materials that they can use to meet specific objectives. Remember to ask what they teach and target your workshop carefully. For each activity, indicate which objectives will be met by it and prepare accompanying handouts. Also, build in time for teachers to chat with each other about what works in the classroom.
- Participants will be more comfortable with EE if they feel confident in their own background and knowledge about environmental issues. You may wish to cover relevant content with a short lecture or a guest speaker.

needs in advance. Entice teachers to think beyond tomorrow: provide examples of units, themes, and extension options for simple activities.

“My day is already full of things I’m supposed to teach.”

Of course it is. That is why you are suggesting they *integrate* environmental education into what they already teach. The activities in this unit should help make that clear, but if you need more examples, use any of the popular EE instructional resources (such as those listed at the end of this unit). Teachers may even be able to *save time with integration*. For example, they can cover both communication skills and social studies objectives by having students debate current environmental legislation in their state.

“How do I give my students a grade?”

In some cases, assessment is straightforward—either the EE activities present concepts measured by existing procedures, or assessment measures are provided with the EE materials. But in many other cases, the integration of EE implies new curricular objectives that are poorly measured by standard assessment. As state education agencies and school systems move to new methods of assessing student learning, there will be additional avenues for teachers to overcome the difficulties of “grading” participation in an environmental action project. For articles on assessment alternatives, see the EE Toolbox *Reference Collection*.

“This isn’t a perfect match with what I need.”

To avoid this problem, you need the right set of instructional materials to show this teacher. Check with others to see what they find useful. If you need more ideas, see the list of resources in Appendix 1 of *Getting Started*. If you have access to a computer and modem, you can also get also specific EE tools and references from EELink, NCEET’s environmental education gopher; for more information on accessing this online resource, contact the EELink staff through e-mail (send to eelink@nceet.snre.umich.edu).

B. Helping Teachers Make The Content Connection

The first workshop strategy emphasized activities, with the facilitator (you) doing the work of identifying teachers’ objectives and finding appropriate EE activities to address them. Given the real constraints that teachers experience, this strategy is often necessary. However, if workshop participants identify their own needs and design their own activities, they may ultimately make a greater commitment to EE and see more opportunities for integration.

This is the goal of the second workshop strategy. To move on to this step, teachers need to have an understanding of their curricula *and* an understanding of the environment in their heads at the same time. If each person in a workshop doesn’t have all the information, encourage people to work together, each providing a relevant ingredient.

This strategy to integrating EE into the curriculum can be called *content integration*, because the new environmental information complements existing content and ties together many different subject areas.

Here are some examples of objectives and activities that teachers might devise to meet them:

- **Physics Objective:** Explain the laws of thermodynamics and give examples.
Activity: Analyze the efficiency of energy production from renewable resources.
- **Math Objective:** Be able to plot a curve.
Activity: Plot the falling curve of the American bison population.
- **Art Objectives:** Express emotion; demonstrate initiative on an independent project.
Activity: Express anger, joy, or sadness in masterpieces created from litter.

- **Language Arts Objective:** Construct a logical argument.

Activity: Write a persuasive letter to protect a local stream.

- **American Civics Objective:** Explain how political perspectives affect the ways that legislation can be interpreted.

Activity: Study the controversy over forest management and spotted owl protection.

Regardless of whether teachers provide a five-minute example or a five-week exploration, the original curricular content goals are achieved through the inclusion of the environmental content. Activity 5, “Charting a Direction for Content Integration,” will help teachers identify their own curriculum connections; Activity 6, “Building Your Own Unit,” will guide them in taking the

“An educated person today is one that knows the right questions to ask.”

*Ernest Boyer, President,
Carnegie Foundation for the
Advancement of Teaching*

next step. Possible starting points for virtually any topic are provided in Master 5, “Sample Connections Between Environment and Existing Subject Areas.”

As you plan a workshop for content integration, consider the following points:

- Are participants willing to develop a rationale and framework that will guide their curricular choices? (If they aren’t, your approach should be more along the lines of the strategy described in Section A).
- Are participants familiar with basic EE instructional materials? This is a prerequisite for this type of workshop.
- Some participants may wish to define EE goals and objectives themselves, or at least critique the ones you offer. Be flexible enough to encourage this level of integration in the workshop.
- Participants may be very interested in evaluating EE curriculum resources based on the objectives they will be teaching. Another unit of the *Workshop Resource Manual*, “Evaluating Instructional Resources,” may be helpful.
- Workshops of this type may be particularly appropriate as units or assignments in a graduate level or preservice course for teachers.

C. Integrating EE to Teach Process Skills

Our third strategy for a workshop on integration emphasizes attitudes and skills rather than subject-specific knowledge. This strategy, called *process integration*, focuses on objectives important to most any subject: critical thinking, cooperative learning, value clarification, multicultural sensitivity. Policy makers in education are becoming supportive of increased emphasis on process skills. This is important to environmental educators. Education that provides learners with process skills is central to the goals of EE.

Teachers of any subject can use EE to creatively address process objectives. They may assign specific projects or, if they desire a more student-centered curriculum, guide students in developing their own investigations and actions. The following examples show some of the many skills that EE can help students develop:

- Researching the African ivory ban and then debating it (group process skills), listing costs and benefits to exporting countries (analytical skills), and writing essays about the topic (communication skills).
- Exploring different perspectives on a local environmental issue and discussing views of business and advocacy groups (understanding different values and attitudes).
- Analyzing environmental success stories to understand how adults and other students solve environmental problems and overcome adversity (increasing knowledge of possibilities).
- Conducting a survey and tallying responses to learn who recycles and how much material and energy is saved (research and math skills).

Examples of Process Goals

To provide opportunities for students to develop:

- the ability to think rationally by using problem-solving skills, applying principles of logic, and using different modes of inquiry.
- an understanding of change in society.
- knowledge of opposing value systems and their influences on the individual and on society.
- a willingness to participate in the political life of the nation and the community.
- an ability to utilize values in making choices.
- an ability to deal with problems in original ways.
- a valuing of meaning in one's activities and discovering one's own philosophy of life.³

Adapted from John Goodlad's "Goals for Schooling in the U.S.," a list derived from his study of state documents.

"We cannot afford to force the minds of today's children into educational experiences that limit their ways of knowing."⁴

*Bob Samples,
author and independent scholar*

- Attending a local hearing, reading the editorials, or campaigning for an environmental referendum, regardless of the content or class (citizenship skills).

Two of the activities in this unit will be especially helpful in demonstrating how EE helps teach process skills: Activity 8, "Charting a Direction for Process Integration," shows teachers how to take local issues and create classroom activities to meet specific objectives; Activity 7, "A Heated Controversy," briefly introduces one way a teacher might handle a controversial issue while building students' analytical skills. Another unit in the *Workshop Resource Manual*, "Approaching Issues in the Classroom," provides ideas for helping teachers use success stories, manage controversy, facilitate student investigation, and consider actions students might take to help resolve issues; these skills and activities are closely aligned with process integration.

As you plan a workshop to cover process skills, consider the following points:

- Are participants really willing to focus on process, not content? Are you all speaking the same language? Clarify the point of the workshop—make sure the participants are ready to focus on process instead of content.

- Ask teachers to bring their own process objectives, or supply them with a sample from another school district. Use what ever you have to make this topic concrete.
- Assess the teachers' experience in handling process skills. Their goal should be to guide student investigation rather than just provide answers, but some teachers may need help letting go of their "expert" status. Alternatively, others may have more practical, hands-on experience with process objectives than you do—in that case, your main role is to help them identify environmental contexts.
- Teachers need time to assess their process integration techniques—and to talk to others about what works. Be sure to structure this time into your agenda.
- Investigate how educators are talking about and teaching process skills—see the EE Toolbox *Reference Collection* for related articles.
- Teachers will commit more effort to process goals if they can define measurable outcomes for students. Consider discussing options for assessment and, again, check the articles in the *Reference Collection*.



Making Sense of the Mix

IN ANY SCHOOL SYSTEM, there are appropriate places for each integration strategy. Districts that have environmental objectives about acid rain, population growth, or global climate change may only need interesting activity ideas and curriculum materials to help teachers accomplish these objectives. Self-contained elementary school classes, where one teacher handles the major subject areas and can link objectives more easily, may be ideal for content integration. Secondary grades tend to have less flexible curricula, but many teachers find ways to use environmental examples. Some secondary schools are initiating interdisciplinary teams, which allow teachers to support each other's efforts to develop students' knowledge along with their problem-solving, communication, and creative-thinking skills (see last example on Master 11).

When EE is integrated into the classroom, it is likely to be a mix of content and process integration, with teachers using existing activity ideas or creating their own and using different integration strategies in different contexts. Ideally, EE will be an integral piece of the formal curriculum: as an expression of a system-wide commitment to solving environmental problems, it will include content-based integration as well as opportunities to explore issues at length in the upper grades. But this is still the ideal. In practice, most examples of effective integration result from the independent initiative of teachers building on their own interests.

In your workshops, you can use the original five examples of integration (on page 4 and Master 11) to spark discussions about how to meet content and process objectives with EE. The projects in these examples take differing amounts of time, teacher expertise, and knowledge, but all have aspects of content and process integration because each meets existing content and process objectives. To help teachers develop integration strategies, you might consider helping them develop an array of options such as those we've discussed and then select the approach that works within their constraints. As you or the teachers read through the examples (Master 11), you might challenge yourself to define the content and process objectives that could be met by each, and the advantages and disadvantages of each. Our comparison of the five classroom examples is given in Table 1 on page 12.



A Bit of Background

PERHAPS THE SCHOOL DISTRICTS near you use certain terms to refer to “integrating EE into the curriculum.” To give you some background for discussions with other educators, this section explains two main approaches to this topic: insertion and infusion. David Engelson, former EE consultant in Wisconsin’s Department of Public Instruction, was fond of clarifying the difference in this way: One inserts a bottle into one’s mouth—when removed, it leaves no trace, though when it is there it is an obvious addition. The liquid from the bottle, however, is infused into the body, into every cell, such that the nature of each cell has changed although the basic function continues.⁵

Infusion, or thematic teaching, is the incorporation of environmental concepts, activities, and examples into existing curricular goals.

Insertion is the addition of an environmental unit or course to the class or curriculum; usually something else is removed.

Infusion could be anything from explaining population dynamics with running games to reflecting an environmental theme in an entire curriculum. In EE’s fully realized form, a district would infuse it into all subject areas, changing instruction throughout the grade levels so that the study of the environment becomes a strand that weaves throughout a student’s entire educational experience. Infusion most often involves content integration. It is sometimes called “thematic” education, where environmental themes are used to supplement and enhance standard subject matter.

The advantage of infusion is its easy implementation. Infusion is implicit in the organization of elementary schools, where one teacher is responsible for all the subject areas. In secondary schools, teachers of language arts, science, or social studies can infuse environmental awareness, skills, and ethics into the curriculum without reorganizing course offerings.

A common disadvantage is that environmental content may be addressed superficially, neglecting environmental problem-solving skills (a problem that can be addressed if teachers and administrators re-evaluate the curriculum and provide staff development opportunities). Further, many teachers often assume that EE should only be infused into science classes.⁶

Insertion, like infusion, can also involve minor or major changes in curriculum. It may vary from slipping a wildlife management unit into a biology course to spending a term studying local issues and their potential resolution. The key difference is that insertion implies adding new objectives to the curriculum, objectives not originally found in a science or social studies framework.

Insertion is an excellent opportunity for teachers who have the knowledge, desire, and freedom to teach an environmental unit or course—they can develop their own skills and prepare curricula that interest them. In some districts, it is also a mechanism to formally commit school authorities to support EE with financial and administrative resources.

The insertion approach is often based on process goals in the curriculum; students have more time to learn about values, cooperation, decision-making, and analysis by studying the environment in depth. A major disadvantage is that a separate environmental course may be regarded as peripheral to the core curriculum, expendable in tight budget years.



Table 1

**Content and Process Objectives
for Each Integration Example**

	Content Objectives	Process Objectives
<p>Project Example Water Conservation</p>	<p>water cycle resource conservation calculation and data analysis comparison shopping</p> <p><i>Features:</i> — interdisciplinary opportunity for real-world skill-building — designed and led by teachers</p>	<p>investigation determining consumer responsibility teamwork</p>
<p>Thematic Example Loons</p>	<p>Native American culture state geography aquatic habitat</p> <p><i>Features:</i> — multidisciplinary opportunity with real-world connections — program can be lead or designed by one teacher — each specific topic involves major research</p>	<p>graphing creative writing appreciation of nature</p>
<p>Content Example Smog in Chemistry</p>	<p>molecular structures chemical reactions atmospheric chemistry</p> <p><i>Features:</i> — minimal change in course content — maintains focus on a specific discipline — designed and led by teachers</p>	<p>analyzing current issues research and synthesis communication skills</p>
<p>Issue Investigation</p>	<p>political process</p> <p><i>Features:</i> — interdisciplinary opportunity for real-world skill-building — teacher designs skill-building; students design investigation — emphasis on student skills and initiative</p>	<p>research and analytical skills application of values communication skills decision-making skills</p>
<p>Interdisciplinary Team</p>	<p>toxic waste production process economic issues calculation and data analysis</p> <p><i>Features:</i> — diverse team provides expertise in several subject areas — theme approach downplays discipline boundaries — requires planning and system support</p>	<p>research and analytical skills presentation techniques persuasive writing project planning/design</p>

The background and ideas in this unit put you in good shape for crafting your own workshop for teachers. The following activities and masters will make the process a bit easier. Don't forget to check other units in the *Workshop Resource Manual* and *Getting Started* for resources and activity ideas.

There may be local "master" teachers who can co-facilitate a workshop with you or an administrator who has recently ushered teachers through an integration process. If you need more assistance, contact your state EE association, state education agency, or resource agency education staff.

Workshop Activities and Masters: Integration

THESE WORKSHOP ACTIVITIES are organized into four sections. A, B, and C build on the three main strategies suggested in this unit; D is aimed at helping teachers get started and choose appropriate strategies for their situations.

Section A offers adaptations of activities originally developed for students, but facilitators can use them to discuss integration opportunities with teachers. You may want to investigate the sources listed for further activities in the same style. These activities demonstrate the multidisciplinary nature of environmental education (EE). (Note that they model integration rather than lead participants in a discussion of integration as a concept.)

1 Water Cycle Skit

Demonstration of integrating EE into a typical science concept, conveyed with dramatics and laughter. Cards are provided on Master 1.

3 Power of the Pyramids

Demonstration of a mathematical exercise with ecological ramifications. Data sheets and discussion questions are provided on Masters 2 and 3.

2 Animal Poetry

Demonstration of integrating nature into creative writing; easily adapted to any setting.

4 Resource-Go-Round

Demonstration of an activity exploring the life cycle of a pencil, with connections to economics, geography, energy, or science. Useful in any setting.

Section B's activities use the "content integration" strategy to help teachers select activities to use in their classrooms. The only magic is that these activities require some familiarity with both the school curriculum and the environmental concepts, so you may wish to pair teachers with those who can provide background for these activities.

5 Charting a Direction for Content Integration

A procedure for working through curriculum or textbook objectives and integrating environmental concepts and activities. Master 4 is an overhead of questions. Master 5 provides dozens of connections between environmental topics and existing subject areas. Teachers can add to the list after working from their own textbooks.

6 Building Your Own Unit

A simplified procedure for helping teachers design their own lesson plans or units—something they can teach from when they leave. Masters 6 and 7 offer an explanation sheet and lesson plan form.

Section C's activities use the "process integration" strategy to guide teachers in developing EE that builds students' skills in critical thinking and communication. A workshop along these lines should rely heavily on the *Workshop Resource Manual* unit "Approaching Issues in the Classroom."

7 A Heated Controversy

Demonstrates the types of skills enhanced by examining the uncertainty and bias present in many controversial environmental issues. Stories on Masters 8 and 9.

8 Charting a Direction for Process Integration

A procedure for developing a unit or investigation that meets the desired process objectives in the school system. Instructions are provided on overhead Master 10.

Section D's activities will help you get your integration workshop started and assist participants in figuring out which approach is best for them. These activities could follow an introduction to EE or precede further explorations of environmental concepts and issues. Use other units in the *Workshop Resource Manual* to help design additional activities about these topics.

9 What Is Integration?

Getting started with integration; an idea for an ice breaker.

10 Five Approaches to Integration

Five case studies of various ways teachers integrate EE into their classrooms. Masters 11, 12, 13, and 14 provide the stories, directions, and blank and completed charts.



Activity 1

Water Cycle Skit

Skit demonstrating the role humans play in the water cycle. Easily adapted to local circumstances.

Objectives

To introduce an environmental drama in a science class; to highlight the human dimension of the water cycle.

Materials

Large cards for each participant in the role play. Put the name of the role on one side and the spoken part on the other (Master 1).

Time: 30 minutes.

Outline

Teachers commonly equate EE with science education. However, environmental lessons add a human dimension that isn't always in the science textbook. The water cycle is an example of a topic that is often learned apart from a human context. Most science texts explain how water moves: cloud - rain - groundwater - river - ocean - water vapor. Where are the people? The toilets? The swimming pools? It is no wonder that kids have trouble understanding that their wastewater may become someone's bath water downstream. This activity demonstrates the human dimension of the water cycle in a humorous way, never failing to raise a chuckle from a group of adults and, of course, fifth-graders!

1

Prior to the workshop, prepare a set of cards that represent the steps of the water cycle in your community. Photocopy and cut out the cards provided on Master 1 and affix them to 4 x 6" cards. On the backside of each card, write the heading (Person, Pipe, etc.) in huge letters. If you need other steps to accurately depict your water system, substitute scripts from the second section ("Additional Cards") or design your own.

2

Introduce the activity as a short skit that will involve about a dozen people, each representing a step in the water cycle. Explain that every participant will get a card and

that most cards will have two statements on the back. They are to read the first statement only once, when they first join the skit. Every other time, they will read the second statement. Other cards will have one statement that will be read each time. Start things off by asking someone with an easy-going sense of humor to play the part of "Person" at the end of the cycle. (You can encourage volunteers by telling the group that the first role is for a person but other roles may be less inviting!)

3

Ask Person to read the first statement. Before you pass out the next card, ask the players how the water gets to Person's home. Work with them until someone says "Pipes!" Hand that player the Pipe card and have him or her read the first statement; remind Person to read his or her second statement.

4

Pass out the Pumping Station card when the group correctly answers the question, "And what keeps the water moving through the pipes?" Then ask that player to read the first statement and have Pipe and then Person answer in turn. As additional players are added, the group will help them and you needn't give the directions again. You might encourage readers to act out their parts as they read their lines.

5

Continue backward through the water cycle until Sun completes his or her turn. After all have read their cards, ask if the water cycle is complete. Players (whether students or teachers) will often think yes. If so, you might ask how Person feels about drinking all this water! Demonstrate that this is a cycle by giving the remaining cards (Toilet, Sewer Pipe, and Wastewater Treatment Plant) to three more participants, line them up on the other side of Person, and ask Sun to start the script again with his or her statement.

6

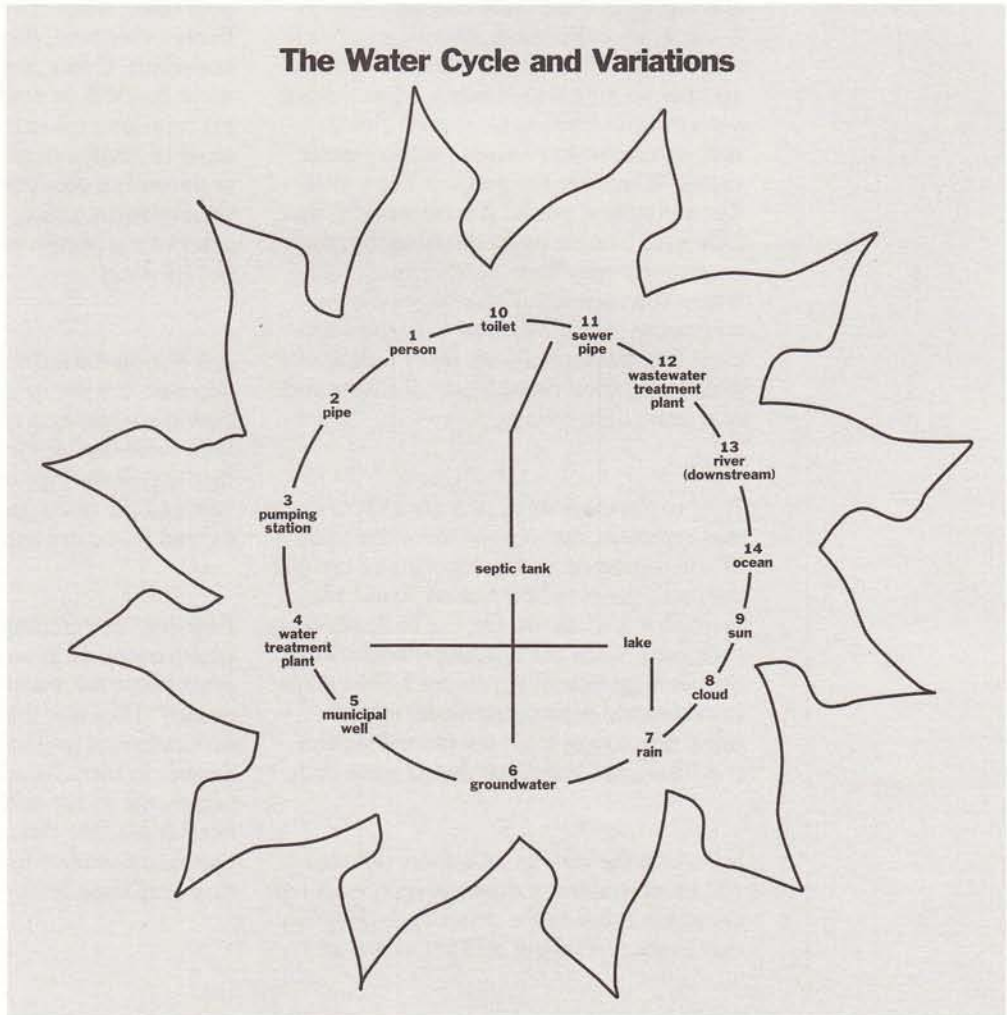
Then ask where their wastewater treatment plant sends the water. Add River and Ocean to the line and start the chart again from Sun.

7

Point out there are several ways this cycle could occur within this town water system. If water evaporates from the River (ask River and Sun to hold hands) or if Person washes the car instead of drinking water (Person links with Groundwater).

Adapted from "The All New Water Revue" by Martha C. Monroe in Science and Children, January 1990, pages 33-35.

The Water Cycle and Variations



Water Cycle Skit: Cards for a Town Water Cycle

Cards for a Town Water Cycle



1
Person

First Time:
I am a person who turns on the faucet and gets a drink!

All Others:
... and I turn on the faucet and get a drink!

2
Pipe

First Time:
I am the pipe that carries water through the town into homes...

All Others:
... where it's carried through the town into homes...

3
Pumping Station

First Time:
I am the pumping station that pumps water into pipes...

All Others:
... that is pumped into pipes...

4
Water Treatment Plant

First Time:
I am the water treatment plant that adds fluoride and chlorine to purify the water...

All Others:
... that purifies the water...

5
Municipal Well

First Time:
I am the well that pumps water from the ground to our town's water treatment plant...

All Others:
... that lifts the water and pumps it into the water treatment plant...

6
Groundwater

First Time:
I am the groundwater that slowly moves through the soil. I may be taken up by a tree, feed a stream, or be drawn into a well...

All Others:
... recharges the ground water and moves slowly toward a well...



7
Rain

First Time:
I am the rainwater that falls to the ground, filling up lakes and feeding rivers. When the rain sinks into the soil, it . . .

All Others:
. . . till it falls as rain to the ground where it . . .

8
Cloud

First Time:
I am a cloud that holds water vapor in the sky . . .

All Others:
. . . where it hangs in the cloud . . .

9
Sun

All Times:
I am the sun that evaporates the water . . .

10
Toilet

(located after Person)

All Times:
. . . Then, the water is flushed down the toilet . . .

11
Sewer Pipe

All Times:
. . . and carried by sewer pipes to the . . .

12
Wastewater Treatment Plant

All Times:
. . . wastewater treatment plant, where micro-organisms feed on the waste material and the water is treated and discharged.

Additional Cards



13

River (downstream)

All Times:

... into a river that flows across the land, fed by the rain, the groundwater, and wastewater treatment plants, and eventually flows into an ocean (or estuary or bay) ...

14

Ocean

All Times:

... where freshwater becomes saltwater and waits to be evaporated by the sun into the sky again ...

Well

First Time:

I am the well that brings water from deep in the ground up to the house, where the pipes ...

All Others:

... where it is pumped from the ground into the pipes, which ...

Septic Tank

All Times:

... septic tank where micro-organisms decompose many of the waste products and return the water to the ground ...

Lake

First Time:

I am the lake that holds water on the Earth's surface until it moves (into a river) or (into our town's water treatment plant) ...

All Others:

... is held by the lake until it moves (into a river ...) or (toward our town's water treatment plant ...)

River (upstream)

First Time:

I am a river that flows across the land, fed by the rain, the groundwater, and wastewater treatment plants, and into our town's water treatment plant ...

All Others:

... which carries the water across the land and into our town's water treatment plant ...

Activity 2

Animal Poetry

Individual exercise in which participants write poems based on their sensory observations of nature outdoors.

Objectives

To demonstrate integration of environmental concepts into language classes; to allow teachers an opportunity to go outside during the workshop; to appreciate the inspirational value of wildlife and nature.

Materials

Writing materials for each participant.

Time: 45 minutes.

Outline

1

Explain that everyone can be a poet, including students who have difficulty reading (and even teachers!).

2

Ask everyone to go outside, find a pleasant spot to sit in, and pick an animal to think about. It may be a house sparrow or squirrel, raccoon or mountain lion. Ask them to close their eyes and think about their animal: imagine where it lives, what it eats, how it eats, how it feeds its young, how it moves, how it feels to move like that, and how the world looks from its perspective.

VARIATION

Insist participants *observe* an animal, so they choose something from an environment familiar to them. This may be easier if you encourage them to think broadly about organisms present, including ants, worms, weeds, or trees.

3

When they return from their "animal adventures," ask them each to write a short poem about their animals. They may do so in pairs or small groups, in free verse, rhyme, or one of the models that follow.

Haiku has three lines of five, seven, and five syllables each.

*Beetles crawled below
moldy bark and wet dead leaves
Leaving tiny trails*

Cinquain is based on five lines with strict purpose, though the number of syllables or

words in each line varies. The title has two syllables or words; the next line describes it in four syllables or words. The next lines describe an action in six syllables or words, then a feeling in eight syllables or words. The last line is another version of the title in two syllables or words.

Panther

Vital, quiet

Moving swiftly to live

Endangered by human patterns

Near lost

Diamante is a poem shaped like a diamond. It is often used to show how words are related through shades of meaning from one extreme to another. The first and last lines are one noun, the second and sixth are two adjectives, the third and fifth are three verbs, and the middle is four nouns.

*egg
light bright
living stretching growing
bird beak wing flight
soaring seeing seeking
feathered fluid
raven*

When all have written their poems, ask for volunteers to read the poems out loud. Ask how typical the assignment is of creative writing, and the likelihood that the outdoors might provide inspiration for some of their assignments. Discuss ways to overcome barriers such as getting kids outdoors and indoors in a timely and orderly fashion.

Activity 3

Power of the Pyramids

Individuals or small groups construct charts illustrating the age distribution of several countries. Techniques use math skills; results invite discussion of population growth.

Objectives:

To demonstrate integration of environmental concepts into mathematics classes; to add a human and environmental dimension to an exercise with numbers; to demonstrate an EE activity that involves seatwork, not outdoor work.

Materials

Copies of Masters 2 and 3, graph paper, calculators, rulers, and colored pencils for each person or team of teachers; one overhead transparency or large sheet of newsprint depicting the example below.

Time: 45 minutes.

Outline

1

Explain that many mathematical concepts can be demonstrated and practiced with data that convey environmental consequences. Human population growth in various countries around the world is an excellent example. This exercise involves constructing population pyramids for several countries and using the pyramids to answer questions that require an understanding and interpretation of the numbers.

2

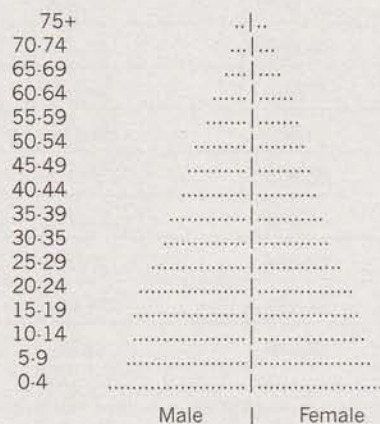
Distribute handouts of Masters 2 and 3 and graph paper to each person or group of teachers. Explain that the numbers on Master 2 represent the population in thousands of each age group of males and females for each country. These numbers let participants build a pyramid by calculating the percentage of the population in each subgroup. Use the example on the next page (on an overhead transparency or flip chart) to show how the percentage at each level can be drawn to visualize the population. To make their charts, participants will need to calculate the percentage of the total population or each age/gender subgroup. For example:

4-year-old males in Kenya = 2,701,000
divided by
total population in Kenya = 24,987,000
equals
.11, or 11% of the total population

On graph paper, the Y axis will be the age groups, with the X axis representing calculated percentages. Bars to the right of the center line are usually female groups, and to the left, male. Genders can be colored differently to make their differences more noticeable. To save time, each group could construct one country pyramid and share it with the full group. Teachers probably need to complete only one to understand the concept. Answering the questions, however, helps participants make sense out of the data. You might ask the questions orally or distribute handouts from Master 3.

Example of a population pyramid

World Population Pyramid (1990)
Age/Sex Distribution



Adapted with permission from Zero Population Growth. "Power of the Pyramids," Earth Matters, Zero Population Growth, pp. 11-17, 1991.

Master **2** Data Sheet

Population in Thousands (1990)

Age	United States				Brazil			
	Male	%	Female	%	Male	%	Female	%
0-4	9,655		9,205		9,616		9,284	
5-9	9,355		8,941		8,993		8,856	
10-14	8,700		8,311		8,173		8,124	
15-19	8,846		8,451		7,425		7,422	
20-24	9,632		9,314		6,919		6,903	
25-29	10,906		10,741		6,752		6,751	
30-34	11,167		11,059		5,754		5,786	
35-39	10,264		10,289		4,853		4,906	
40-44	8,823		9,016		3,891		3,932	
45-49	6,868		7,163		3,053		3,098	
50-54	5,564		5,925		2,596		2,670	
55-59	5,059		5,569		2,095		2,201	
60-64	4,991		5,785		1,729		1,860	
65-69	4,530		5,564		1,285		1,422	
70-74	3,488		4,660		885		978	
75+	4,275		7,726		903		1,112	
Totals	122,124		127,716		74,891		73,305	
	(Total Pop.: 249,841)				(Total Pop.: 150,196)			

Age	China				Japan			
	Male	%	Female	%	Male	%	Female	%
0-4	55,782		53,655		3,536		3,376	
5-9	44,942		42,316		3,814		3,626	
10-14	49,905		46,040		4,368		4,144	
15-19	63,890		59,174		5,137		4,876	
20-24	65,818		61,211		4,586		4,362	
25-29	51,882		50,504		4,155		4,018	
30-34	43,832		40,254		3,933		3,858	
35-39	45,043		41,707		4,539		4,476	
40-44	33,588		30,066		5,367		5,312	
45-49	26,306		32,015		4,506		4,551	
50-54	24,449		21,333		4,018		4,101	
55-59	22,224		19,912		3,798		3,943	
60-64	17,897		16,601		3,219		3,499	
65-69	13,536		13,557		2,160		2,888	
70-74	9,077		9,977		1,513		2,206	
75+	8,307		11,199		2,069		3,394	
Totals	576,479		540,523		60,714		62,630	
	(Total Pop.: 1,117,002)				(Total Pop.: 123,344)			

Age	Kenya			Austria		
	Male	%	Female	Male	%	Female
0-4	2,701		2,661	218		207
5-9	2,191		2,171	240		226
10-14	1,743		1,748	224		211
15-19	1,267		1,269	257		244
20-24	1,016		1,013	311		298
25-29	829		856	328		317
30-34	641		687	292		284
35-39	500		530	255		252
40-44	386		405	255		250
45-49	290		315	256		257
50-54	234		255	221		225
55-59	195		208	186		199
60-64	154		164	171		217
65-69	111		116	149		242
70-74	76		78	80		140
75+	88		89	157		342
Totals	12,421		12,566	3,608		3,912
	(Total Pop.: 24,987)			(Total Pop.: 7,520)		

Questions About the Population Pyramids

From an environmental impact perspective

1. Which gender has the higher population in the youngest age groups on every pyramid? Why is that the case? Which gender has the higher population in the oldest age groups? Why might that be so?
2. Of the six graphs, which two look most like pyramids? What does that indicate about the population growth rates in these countries? If birth and death rates remain the same in these countries, what will the pyramids look like in 25 years? What factors would change the shape of the pyramids?
3. Looking at the pyramids, which country appears to have the slowest rate of population growth? How can you tell? If current trends continue, how might this pyramid look in 25 years?
4. How do the pyramids for Japan and the United States compare? Which of the two countries do you think has the higher fertility rate? To what might the bulges in the middle of each pyramid be attributed?
5. What is different about the shape of China's pyramid? What unique factors have given the pyramid this shape?
6. For each country, determine the percentage of the population that has yet to reach childbearing age (i.e., people under age 15). What do these numbers say about the prospects for future population growth?
7. Which countries' pyramids are closest to the sample "World Population Pyramid"? What conclusions can you draw from this?

From a mathematical perspective

1. If the birth rate were constant over time, then the population of older age groups would always be less than the population of younger age groups.
 - Notice that the 5–9-year-old population is greater than the 0–4-year-old population in Japan and Austria. Explain this. Look at the sentence above for a clue.
 - Assume that the birth rate is constant. What percentage of children in the first age group survive to the second age group, in Brazil and in the United States?
2. Use the population data to construct a pie diagram, a bar chart, and a line graph (on graph paper or with graphing software). Which kind of display is most effective? Why?
3. In Kenya there are approximately 50 births per 1,000 population per year, and 9 deaths per 1,000 population per year (1989 figures). What is the percentage change in population, per year? Use the equation for exponential growth to predict the population of Kenya in 20 years if the growth rate remains constant.
4. In Austria there are approximately 12 births per 1,000 people per year, and 12 deaths per 1,000 people per year (1989 figures). What is the percentage change in population per year? Use the equation for exponential growth (or common sense!) to predict the population of Austria in 20 years, if the growth rate remains constant.
5. How many women in Kenya are in their child-bearing years (15-40)? What percentage is this of the total population? What is the percentage in Austria?

Activity 4

Resource-Go-Round

Group discussion investigating multidisciplinary approaches to the analysis of consumer product life cycles.

Objectives

To demonstrate an activity, based on environmental information, that has many connections to social and natural science topics; to demonstrate that an environmental impact analysis can be built on questions that are basic to most subject areas.

Materials

Chalkboard and chalk or newsprint and markers.

Time 30 minutes.

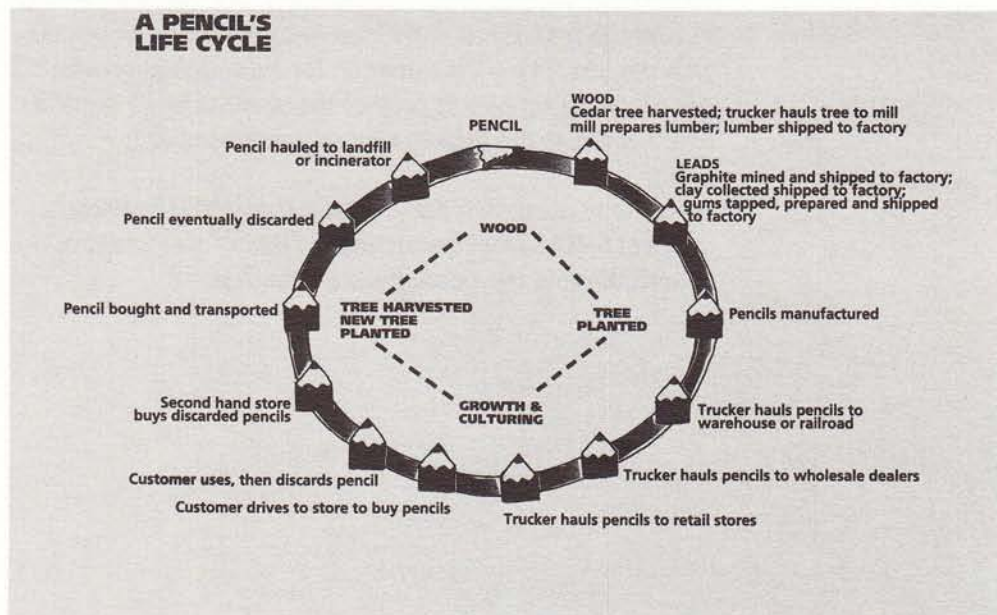
Outline

Virtually all of the products, items, and materials in our lives, from clothes and food to cars and CDs, are made from resources found in the environment. The process that transforms minerals or chlorophyll to computers or pizza and eventually into a waste product is the Product Life Cycle. By comparing product life cycles, or simply by becoming more aware of one product's history and future, teachers and students can learn a great deal about the world around them. Find additional information in the original "Resource-Go-Round" activity from Project Learning Tree (see "Resources" on page 55).

1
Choose one conspicuous item in your meeting room—the easel, your shirt, the coffee pot—and ask teachers to think about the path this item took to get here. What is it made of?

2
As they begin to give you answers, write them on the board so that you will eventually form a circle. It may look something like the graphic below.

Make sure that all the basic elements are listed before you go on to production phases.



Leave empty boxes for phases that need more research. Draw a squiggly line to indicate transportation and an incoming arrow for energy, if your teachers provide such detail. As you work up to the product, remind the group they aren't done yet. A life cycle continues from there. What happens when this product discarded? repaired? recycled? reused?

3

With the product life cycle as complete as possible, ask teachers how this activity might enhance traditional subject areas. Lead a discussion that covers examples such as the following.

- **Economics and Math**
the price paid for the product along the cycle.
- **Geography**
the sources of each ingredient of the product.
- **Energy**
the transportation and other energy involved in each phase of the cycle.
- **Chemistry**
the chemical reactions used in the manufacture of common products, or the hazardous waste generated by this product.

- **Earth Science**
the mineral resources or hazardous wastes in this life cycle.
- **Political Science**
the treaties that protect resources and markets for products.
- **Health or Home Arts**
the environmental impact of the product in each phase of the cycle.

4

Teachers will readily see how this activity may be used to compare similar products as well. They may hope to settle, once and for all, questions Americans have been asking about choices such as cotton diapers vs. disposables and paper bags vs. plastic ones. Unfortunately, it is difficult to measure and quantify the environmental impact of each process. How might students approach the question of "Which product is best for the environment?"

"Resource-Go-Round" is adapted with permission from Project Learning Tree, 1993, pp. 316-319.

Activity 5

Charting a Direction for Content Integration

Small group exercise to develop connections between existing subject-based curriculum goals and possible environmental activities.

Objectives

To brainstorm connections between a given curriculum and environmental concepts; to expose participants to helpful EE resources.

Materials

Teachers may wish to bring their textbooks or curriculum outlines; you may wish to provide sample texts or curricula on a demonstration (see resources listed in this unit). An overhead from Master 4 and handouts from Master 5 are optional.

Time 45 minutes to two hours.

Outline

1

Ask the teachers to work together in pairs or small groups. Some facilitators prefer to put similar subject or grade level teachers together; others like to form heterogeneous groups based on the premise that diversity will breed creative ideas.

2

Ask each group (or individual) to begin a chart of its curriculum goals. Have group members put four or five content objectives on the left side of the page and a row of interesting environmental concepts and local environmental issues across the bottom. You might direct them to focus on either specific, short-term objectives or on long-range goals for the entire year. Pairs could help each other do one or both charts.

3

The next step is to fill in the center of the matrix with ideas. Those ideas will represent ways the environmental concepts can enhance, illustrate, and elaborate on the content objectives on the left. Here are some questions that may assist the brainstorming

process. You may wish to post them on newsprint or project them with an overhead (see Master 4).

- What in the environment illustrates this content objective?
- What impact have humans had on this subject, now or in history?
- What difference does a healthy environment make regarding this objective?
- What effect does this content objective have on the environment?

On the next page is an example of a completed matrix.

To encourage teachers to develop their own concepts and topics, use Master 5 as a guide and give teachers more time to discuss ideas with each other. To point out the concrete ideas that already exist in activity guides, encourage teachers to use the indices in the back of Project WILD or Project Learning Tree curricula to identify topics that have environmental connections. This will direct them to WILD and PLT activities that address content, which could give them ideas for other classroom suggestions; however, note that this often makes it difficult to generate original ideas. Demonstrating some activities and allowing teachers to discuss connections is another option.

Charting a Direction for Content Integration in Middle School English

Content Objectives

Identify controversy in literature.

Construct an effective essay.

Develop interviewing techniques.

Environmental Concepts:
local toxins, energy conservation, planning urban environments, nature appreciation.

Integration Ideas

Read "The Man Who Planted Trees" and discuss the author's portrayal of the environment and how humans treat it. Relate this to a current issue.

Research a local environmental issue and write a three-minute speech to the city council; write a piece for *Time*: "An Environmental Issue that Matters Most to Kids."

Interview elderly citizens about energy conservation 50 years ago. Survey family attitudes and report on their transportation habits and concerns.

4

When the charts are filled with environmental concepts that enhance the original content, the next step is to support those ideas with activities. Some teachers will be content to create lectures, reading assignments, or research projects. But others may become more excited about EE if they have some help with interactive learning ideas: role plays, running games, moral dilemmas, songs and skits, experiments, simulations, interviews, field trips, group projects, and speech writing. There are hundreds, maybe thousands, of activities in EE guides across the country; all are designed to make it easier for teachers to construct a unit or program. It could help to have some of these available for teachers to look through as they

consider a variety of ways to teach about the environment. See "Resources" at the end of this unit, the *Workshop Resource Manual* unit "Using Community Resources," and the curriculum lists in *Getting Started* for suggestions of local and regional sources of information.

VARIATION

Some teachers find that examples of how their colleagues integrate environmental concepts into the curriculum are very helpful. You may wish to invite several seasoned teachers to present short descriptions of their units and classroom experiences. Use these stories as springboards for different issues or subject areas.

Charting a Direction for Content Integration

- a. What in the environment illustrates this content objective?

- b. What impact have humans had on this subject, now or in history?

- c. What difference does a healthy environment make regarding this objective?

- d. What effect does this content objective have on the environment?

Sample Connections Between Environment and Existing Subject Areas

Subject Areas

There are many connections between any school subject and the environment. This list has many examples to help you get started.

American History

Native American land use patterns
 Attitudes toward land and natural resources throughout history
 Teddy Roosevelt, Gifford Pinchot, and the conservation of public lands
 Influential figures in American resource history: Boone, Audubon, Pinchot, Muir, Leopold, Comstock, Thoreau, Carson
 Resource use and productivity: beaver, forests, water power, minerals
 Development of environmental legislation
 Impact of civil rights and anti-war movements on the environmental movement

World History

Land use patterns in other cultures
 Environmental effects of war
 Migration, population, and resource use over time
 Role of resources in the location and rise of civilizations
 Resource distribution and conflict resolution in other countries
 Population growth; Malthus
 Global issues and options for resolution: nuclear testing, ozone hole, ocean pollution, acid rain, biodiversity
 Role of the United Nations
 Multi-national companies and environmental restrictions; GATT, NAFTA

Psychology

Preferences for certain environments
 Stress and urban crowding, territory
 Restoration and the role of nature, gardening, wilderness
 Workplace environments and views of nature
 Citizen participation in environmental decision-making

Civics

History of environmental legislation
 Politics of current state or national legislation
 Role of environmental organizations in politics
 Collect physical data or opinions on local environmental issues
 Attend or speak at public hearings or city council meetings
 Work with advocacy group to assess or influence public opinion

Home Economics and Consumer Education

Vegetarian diets and environmental impacts
 Food and cosmetic testing on animals, bacteria, and people
 Household energy conservation techniques
 Environmental impacts of regional, seasonal, or organic foods vs. other varieties
 "Biodegradable" and "photodegradable" plastics vs. regular plastics and cellulose
 Make and test alternative household cleaning products
 Install and test water conservation devices
 Evaluate routes for local public transportation
 Determine products that contain post-consumer recycled materials
 Test energy-saving light bulbs around school

Health

Toxicity from the workplace and from environmental contaminants
 Radioactive materials and waste; transportation and depositories
 Food, nutrition, and hunger
 Air quality; water quality; noise pollution
 Solid waste and disposal options
 Human population growth, birth control
 Definitions of "environmental quality" and "voluntary simplicity"

Chemistry

Household hazardous products and wastes
Production and consequences of acid rain
Water quality tests and water purification
Waste water treatment procedures
Air pollution and compliance regulations
Fertilizers and pesticides and agriculture
Organic farming
Soil, decomposition, composting, and erosion

Biology

Toxicity in birds and predatory fish
Population growth; carrying capacity
Effects of increased solar radiation
on plants and animals
Production, use, and licensing of pesticides
and fertilizers
Integrated Pest Management
Biodiversity
Hunting for sport, food, and money;
endangered or game species
Genetic engineering
Habitat restoration
Captive breeding and genetic bottlenecks

Earth Science

Groundwater movement and contamination
Mining and restoration
Soil erosion
Recycling and reusing resources
Track groundwater movement from data
on contaminated wells

Physics

Energy sources, both traditional
and alternative
Efficiency of sources, machines, and vehicles
Laws of Thermodynamics
Tour local power plant

Mathematics

Study population growth and change (human,
endangered species, game animals)
Predict population doubling time
Calculate landfill capacity
Triangulate to locate radio-collared animals
Determine carrying capacity of an ecosystem
Collect data on automobile use, energy con-
sumption, water use, resource efficiency,
soil erosion, water percolation, or waste
production
Present data in graphs or charts

Computer Science/Technology Education

Graph and present data
Search networks for resource information
Run simulations of environmental change
Conduct conferences with students in other
regions
Run statistical tests
Print newsletters and posters

Language Arts

Vocabulary of environmental terms
Impact of environment on language; idioms,
slang, cultural changes
Read about nature and environmental issues
Read about solutions and success stories
to environmental problems
Analyze case studies and stories of environmental
issues
Apply persuasive tactics to change opinions
about environmental issue
Use libraries to research environmental issues
Interview professionals, elderly citizens,
and others about environmental concerns
Practice writing and speaking effectively
about the environment

Activity 6 Building Your Own Unit

A systematic approach to creating an environmental unit, using a common lesson planning design.

Objectives

To practice creating lesson plans and units that integrate environmental concepts into the curriculum; to gain inspiration from the ideas of other teachers; and to present resources to help teachers integrate EE into their curricula.

Materials

Handouts from Masters 6 and 7; EE activity guides for teachers to peruse; lists of textbook or curriculum objectives from participants' school districts.

Time One hour.

Outline

Many teachers expect to leave a workshop with something they can use in their classrooms; something from which they can teach. Even if these teachers wish to wrestle with content integration issues, they can appreciate something they have worked on that can enhance their own curricula. This activity provides a guideline for helping them adapt an existing activity, use several activities to create a unit, or use their colleagues as a sounding board in creating new ideas for the classroom. This activity might also be helpful for a facilitator with a resource management background to approach lesson planning from a teacher's perspective.

1

Explain that in the next hour, they will work in pairs to design a "lesson" they can use with their students. Although they all have effective ways to design lesson plans, build units, and cover material, you would like them to use your framework this time, so that everyone can work together. Your framework is a combination of several popular learning theories; Madeline Hunter and Bernice McCarthy have developed similar models.

2

Using handouts from Masters 6 and 7, explain that this lesson planning process asks them to create a learning environment for their students in four distinct phases. In the first phase they are attracting attention, offering a reason to learn this information, participating in an experience, demonstrating relevance, and assessing prior knowledge. In the second, the majority of the information about the topic is shared or reviewed. In the third, the main concepts are reinforced with additional examples or manipulated with an experience. Finally, the information is applied to the students' world through practice. On the next page are two examples of how teachers have used this format.

3

As the teachers get started, they will first need to choose a topic, unit, or objective in their curriculum that they would like to develop with an environmental theme. Reviewing their text, their curriculum, EE activity guides, or Master 5, and discussions with other teachers may be helpful. Of course, if the environmental issue is a given, you can help them determine how to fit it into their curriculum.

Lesson: Coral Reefs and How They are Formed—science

- I. Distribute a piece of coral, examine and describe it
- II. Short lecture on coral polyp; its structure and the role of algae
- III. Simulate coral's formation of calcium carbonate precipitate by demonstration
- IV. Small group discussion of what coral reefs need to remain healthy

Lesson: Radioactivity and Half-Life—math or science

- I. Read newspaper article about a nuclear power plant release of "hot" water
- II. Explain radioactivity and half-life decay
- III. Solve math problems with the decay rates of several elements
- IV. Debate pros and cons of current radioactive materials storage procedures

4

Ask teachers to work in pairs with someone who teaches something they teach. They can create one lesson together or help each other design two lessons. Distribute blank Lesson Forms (Master 7) and circulate to help answer questions. Encourage them to use the EE activity guides you supplied to find elements for their lesson plans—an exciting introduction or application activity. Explain that the guidelines on the form are to help them build a lesson that engages learners who have different learning styles. They will, in essence, have

four different teaching elements, each with different objectives. The space labeled "Remember" is for teachers to note the types of questions they would ask at this point, what materials to get ready beforehand, how to assess student learning, etc.

5

When the group finishes, ask several teachers to briefly describe their lesson to the others, and encourage them to provide helpful suggestions and modifications.

Lesson Plans—One Model

As a teacher, you have many different goals to fulfill. Your material needs to do more than meet the curriculum objectives and introduce environmental information—it also must accommodate the various learning styles of the students in your class. The following Four-Step lesson plan process will help you cover concepts in several different ways to maximize learning and retention.

Step 1: Motivation

Begin with an introduction to the topic that interests the students, explains why they should pay attention, and relates the topic to their lives. By asking good questions, you may also discover how much they already know about the topic, or whether they hold misconceptions that may interfere with learning new information. You can use pictures, stories, news articles, games, physical props, and other devices to introduce the concept and motivate students. Grab them.

Step 2: Information

Using a variety of learning aids and activities, convey information to students. You may wish to lecture, explain, engage them in a discussion, introduce new vocabulary, conduct a demonstration and ask questions, or show a movie. Using the environment to enhance your lesson may take you outdoors, to the wastewater treatment plant, or to the grocery store! Give them the information.

Step 3: Practice

If you have carefully targeted what students should learn in this lesson, you'll be able to create ways for them to practice this skill or use this concept. Games, exercises, discussion groups, experiments, or other activities might help them review the concepts you have explained in Step 2. Let them try it.

Step 4: Application

Finally, you will create an activity that will help students apply this concept in a new situation. Homework and group projects can allow you to evaluate what the students learned. This phase could include moments of self-discovery as students move into new territory. Let them teach themselves.

*Adapted from materials from the U.S. Peace Corps
Office of Training and Program Support.*

Lesson Plan Form

Teacher's Name

Grade Level

Subject Area

Title of Lesson

Objective that it meets:

Part I: Motivation

Attract, engage, and create an experience

Objective:

Activity:

Materials, visuals, or resources needed:

Remember:

Part II: Information

Integrate the experience and teach the concept

Objective:

Activity:

Materials, visuals, or resources needed:

Remember:

Part III: Practice *Manipulate and practice the concept*

Objective:

Activity:

Materials, visuals, or resources needed:

Remember:

Part IV: Application *Apply concepts to students' personal experiences*

Objective:

Activity:

Materials, visuals, or resources needed:

Remember:

Activity 7

A Heated Controversy

Participants read two "scientific" views of global climate change. They discuss alternative interpretations and consider how to handle this controversial issue with students.

Objectives

To demonstrate that the uncertainty and confusion about controversial environmental issues can help create an activity for students; to demonstrate how activities can help build skills in analysis and problem solving; and to demonstrate what a teacher can do when she or he doesn't have the "all the answers."

Materials

Handouts from Masters 8 and 9.

Time 30 minutes.

Outline

Information, predictions, and fears about global climate change have been reported, misquoted, and misperceived for several years. The complexity of the issue and the associated uncertainty do not help. The following articles help make clear how different assumptions lead to different information, and how certain biases skew reports and predictions.

1

Distribute copies of Masters 8 and 9 (Scientist 1 and Scientist 2), with half of the group receiving each. Explain that they are receiving two different views of global climate change. (All of the information presented has, in fact, been expressed by members of the scientific community.)

2

After giving participants time to read the assigned story, ask members from each group to respond to these questions:

- Are we experiencing global climate change now?
- Are we likely to experience global climate change in the future?
- What evidence supports your responses?
- What should we do about it?
- What assumptions about science and change are being made by this scientist?

3

Now distribute the other story to each group. After giving everyone time to review it, your discussion could include these questions:

- What are the advantages and disadvantages of each version?
- Can you think of a course of action that is a compromise between these two plans?
- Who should make decisions that affect all of us and the environment?

4

Finally, ask teachers to consider how they might use or change this activity with their students:

- What age level is most likely to benefit from this type of activity?
- What other issues could be approached in a similar manner?
- What skills are we asking students to practice as they read conflicting viewpoints?
- What other activities could assist students with these skills?

Adapted from "A Heated Controversy," pp. 45, 54, and 55 in Pollution: Problems and Solutions, NatureScope®, 1990.

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° Fahrenheit. That may not seem like much of an increase, but keep in mind that temperatures today are only about nine degrees 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 3–10 degrees 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 relatively sudden changes in their habitats. Some species are likely to become extinct.

Some people claim we should wait until we are 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% 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 by taking public transportation instead of driving their cars so much and by buying more energy-efficient appliances. And we have to stop the burning of the 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.

*From "A Heated Controversy,"
p. 54 in Pollution: Problems and Solutions,
NatureScope,® 1990.*

Scientist 2

There has 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%—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° Fahrenheit. 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 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.

*From "A Heated Controversy,"
page 55 in Pollution: Problems and Solutions,
NatureScope,® 1990.*

Activity 8

Charting a Direction for Process Integration

Small groups discuss and present ideas for using EE to address cross-disciplinary problem-solving and communication skills. Use the "Approaching Environmental Issues in the Classroom" unit for more workshop ideas on this topic. Activity 10 may be a useful way to prepare participants for this activity.

Objectives

To identify relevant process goals in the curriculum; brainstorm opportunities for EE activities that meet process goals; and consider resources to assist teachers in meeting such goals.

Materials

Sample goals for school district or K-12 curriculum; instructional resources for teachers to peruse; blank pages and writing utensils; an overhead or flipchart from Master 10; local newspapers.

Time One hour.

Outline

Ask participants to work together in pairs or small groups. Encourage teachers of different subjects or grade levels to work together.

1

In groups, have participants think of their process-oriented curriculum goals (e.g., skill development in group process, cooperation, communication, listening, analyzing, evaluating, creative thinking). Have them write these objectives on the left side of a page.

2

Next, have them list interesting environmental issues in a line across the bottom of the page. A newspaper may be a good source of ideas.

3

The next step is to fill in the center of the chart with ideas. These ideas will represent examples, investigations, case studies, and questions about the environment that will enhance, illustrate, and elaborate on the objectives on the left.

Here are some questions that may assist the brainstorming process for Steps 1–3. You may wish to post them on newsprint or project them with an overhead (Master 10).

- What are some interesting environmental issues in our community?
- What skills do I want students to practice, and what prerequisites do they need in terms of knowledge and experience?

- How extensive will this effort be? Will this summarize a unit with one brainstorming activity, or is this a project that will take a month? When are we done?
- What interventions might be necessary to develop group process and communication skills? Activities without context may be extremely helpful to allow students to focus on the importance of these skills. (Pfeiffer's Human Resource Development materials have helpful ideas—see page 56.)
- What should my role be? What do I need to play these roles well?

If some teachers are thinking of a major effort to help students practice skills of investigation and action-taking, it may be difficult to be specific about their class activities, since the act of choosing a problem to investigate is one of the skills. Direct these teachers to work on planning the design of their projects and thinking about the assistance they will provide their students. Use the resources listed at the end of this unit.

4

Ask the groups to briefly report what they have done, reflecting on difficulties they encountered in their plans, difficulties they imagine they will encounter, suggestions they can share with each other, or additional resources they need from you or your organization.

Charting a Direction for Process Integration

- a. What are some interesting environmental issues in our community?

- b. What skills do I want students to practice, and what prerequisites do they need in terms of knowledge and experience?

- c. How extensive will this effort be? What timeline do I have? What criteria tell us we are done?

- d. How can I develop my students' group process and communication skills?

- e. What should my role be—information provider, facilitator, cheerleader, advisor? What do I need to play these roles well?

Activity 9 What is Integration?

Brief introduction (in large group discussion) to general options for adapting EE to meet content and process objectives.

Objectives

To introduce teachers to the rationale behind adding environmental concepts to the existing curriculum; to engage teachers in discussions about their own curricula and teaching processes.

Materials

Chalkboard and chalk or newsprint and markers; slides and projector (optional).

Time 20 minutes.

Outline

Introduce this session by acknowledging the daily and yearly schedule limitations faced by teachers. One way of doing this is to project an overhead transparency of a table of contents from a familiar text. Ask how many in the group believe that they can realistically teach all this material in one year (or semester). Now suggest that 10 minutes be cut from each hour of class to address environmental issues. You've demonstrated that few teachers have the latitude to tack on ("insert") EE into the curriculum. Then generate some discussion about what integrating EE means, either as a large group or through small groups.

1

Ask a few teachers to state some of the objectives they are currently working on in their classrooms. Make two columns on the board as they generate examples, with content-related objectives on the

left and process-related objectives on the right. Keep the lists short—the idea is to come up with representative examples while emphasizing that there are both content and process objectives.

2

Ask some other teachers to suggest an example of an EE project, activity, or unit (or provide your own example). Again, make a short list of the content and process learning objectives and write them below the first lists.

3

Now, define integration as the process of using the environment to enhance existing curricular goals, thus achieving both the original goals and EE objectives at the same time. Briefly discuss options (while inviting participation) for making environmental connections to the current content and process objectives.

For example....

I. Current Content Objectives

- Know first white settlers in area.
- Define groundwater.
- Demonstrate proper use of commas.

Current Process Objectives

- Be able to sequence events.
- Use map coordinates.
- Build cooperative skills.

2. An EE project on groundwater involves measuring local rainfall and soil percolation, defining groundwater, talking to well drillers, reading a story about leaking underground storage tanks at a gas station, and learning how groundwater is “cleaned” once contamination is discovered. The project includes process skills of measuring, analyzing, interviewing, working in groups, etc.

3. Teachers may make some of these suggestions:

Environmental Content Objectives

- Investigate historical changes in local ecosystem.
- Define groundwater and its uses.
- Read environmental literature.

Environmental Process Objectives

- Plot timeline of ecosystem changes.
- Map local surface watershed.
- In pairs, edit short essay about animals.

Small groups consider alternative approaches for integrating EE, from minor additions to a lesson plan, to major changes in the curriculum

Objectives

To give examples of mechanisms for integrating EE into the curriculum; discuss and compare options; and consider the options for teacher's own curriculum objectives.

Materials

One copy of each set of cards from Master 11 for each small group. (Handouts or overheads from Masters 12, 13, and 14 are optional.)

Time One hour.

Note

The terms used to identify each approach are not official, just somewhat descriptive. Master 13 gives you some ideas of ways to compare these approaches with teachers.

Outline

1

Assemble participants into five-person groups. Give each group a set of the five stories on Master 11. Ask each participant in the group to take a card and one of the following roles.

Facilitator

Keeps people focused on the task

Timekeeper

Lets people know how much time remains to complete the task

Recorder

Takes notes of the discussion

Equalizer

Ensures that everyone has a chance to speak and a variety of views are heard

Reporter

Makes a presentation to the large group

2

Direct each person to explain and represent the type of EE integration described on his or her card. The task for each group is to review the five versions of integration together, and to discuss the following questions in the allotted time (30 minutes):

- What are the similarities between the approaches? What are the differences?
- What are the advantages of each approach to the school system, teacher, and student?
- How might each approach be implemented in your school system?

You may ask the groups to complete the chart on Master 13 as they answer these questions. Circulate among groups and answer questions.

3

When they have completed the task, ask the recorder from each group to give everyone a sense of what the group seemed to like the best about one of the examples on the cards. Lead a brief discussion about the advantages and disadvantages of these approaches to integration. (You can compare their answers to those on Master 14, or simply keep this for your reference.) Ask teachers how they would like to approach integration in their classrooms and schools.

Case studies adapted from the following materials:

"Environmental Education in the K-12 Curriculum: Finding a Niche," by John M. Ramsey, Harold R. Hungerford, and Trudi L. Volk, 1992. *Journal of Environmental Education*. 23(2):35-45.

Getting Started: A Guide for Bringing Environmental Education Into Your Classroom; David Bones, editor, 1993. Ann Arbor Michigan: NCEET.

"Courting Controversy: How to Build Interdisciplinary Units," by Jackie Williams and Terry Deal Reynolds. *Educational Leadership*, April 1993 (Vol. 50, no.70), pp. 13-15.

Five Approaches to Integration

The Project Example

Bonnie Denton and the other middle school home-arts teachers in Calvert County, Maryland, were a little startled by their colleague's challenge. We do waste a lot of water, she boldly pointed out . . . but what could home-arts teachers do about that? Over time, an idea took shape as the teachers met with their county supervisor and the state and county EE coordinators. Yes, they could teach water conservation! They generated several important concepts that could be in their unit on water conservation, concepts that also enhanced their curricular goals. They also wrote a proposal to the Chesapeake Bay Trust for funds to purchase water restricting devices, enough for all of their seventh-graders to install in their homes.

When the \$700 proposal was funded, the teachers began collecting resources and developing activities. Their two-week unit involved showing a film, "Down the Drain," and reading a booklet, "The Story of Drinking Water." Activities included calculating the cost of water if purchased in Perrier bottles, one quart at a time; estimating the student's daily water use; and discussing ways to alter daily habits to use less water.

The faucet flow restrictors and toilet dams were the highlight of the unit. They were first demonstrated in the classroom. The students learned how to install them and then asked their parents if they wished to have the student-plumbers install the devices at home. Even after the unit was completed, the students continued to inspect their families' water bills and calculate the savings.

The project was recently identified as an important element of the county's new service-learning program, and the now home arts teachers are eager to expand their formula to other conservation efforts. For example, their students currently use donated scrap fabric to make seals to prevent drafts, an effort that could grow into an energy unit.

The Thematic Example

After a summer vacation in northern Wisconsin, Margaret returned to her third-grade classroom full of new ideas—loony-tune ideas, to be exact. When she and her family camped on a lake occupied by loons, she had become entranced by the beautiful birds, their haunting evening calls, and their expert fishing skill. Her interest led her to the local Department of Natural Resources office, which supplied her with a poster and brochure on loon habitat and recent population decline. At a nearby tourist gift shop, she bought a recording of loon calls and songs.

Margaret decided she could use loons as a theme through which everything she taught would be addressed. Math was easy—the DNR brochure included population numbers, which provided a means to help students understand graphs. Geography was relevant too. On Margaret's huge map of Wisconsin, groups of students put colored pins in each of the loon lakes and measured the distance from the middle of each lake to nearby roads and towns. A short story about loons mentioned their migration to the Gulf of Mexico, which created more interest in Margaret's map.

In language arts, Margaret asked the students to read several magazine articles about loons and write their own poems about a day in the life of a loon. Students illustrated their poems and posted them on the back wall, near the huge loon silhouette Margaret had crafted from black construction paper. A Native American myth, "Why the Loon Wears a Necklace," had seemed to really spark the students' imagination, and Margaret noted that such stories would complement other wildlife studies throughout the year. For a science unit, Margaret introduced students to the loon's habitat and the challenges of wilderness life for loons in northern Wisconsin. Around the silhouette and poems, students added to the lake ecosystem with pictures of other outdoor creatures: beaver, mink, perch, musky, mayfly, dragonfly, snake, and great blue heron.

After two weeks, Margaret left loons for another topic, but her mind continued to reflect on new activities she might include next year—for instance, helping the students coordinate a fundraiser so they could donate money to Project Loon Watch.

The Content Example

Jim's text neatly outlined what he considered the major topics for a tenth-grade chemistry class. He and his students were comfortable with the pace and style of the text, which had been a top choice of California's text selection committee. Still, there was something missing. The text defined the boundaries for student learning and reinforced their belief that chemistry was simply an academic subject. Jim knew that his own knowledge of chemistry contributed broadly to his understanding of science and society. How could he communicate these connections to his students in interesting ways?

He began by discussing news articles from the Los Angeles Times. At first he chose articles from the "science page" that highlighted material he was presenting in lecture—fuel cells, "buckyballs," and irradiated food. His effort to make chemistry relevant was moderately successful. Still, he could see that these topics were not part of most students' everyday experiences. It didn't occur to Jim to focus his news discussion on environmental issues until a student asked about an article describing recent proposals to control hydrocarbon emissions. These regulations would affect cars, dry cleaning, gas pumps and a hundred other sources contributing to southern California's smog. The other students' questions were simple: "How could charcoal lighter or paint become smog?" "What does ozone have to do with smog?" "I thought ozone was supposed to be good!" Jim realized that this was a perfect example of an environmental issue that could not be understood without chemistry.

His next step was to initiate a discussion of whether the proposed air quality regulations were justified. Not surprisingly, the students' reactions were based more on feelings and personal experience than on data. But by exposing these feelings, he had created a need for data, because the students wanted to support their arguments. Jim gave them one class period to search through *Time*, *Newsweek*, and other popular publications for answers to questions they had generated as a class. When he asked the students specific questions about what they had learned, they discovered that they needed better information. He gave them a second period to use the textbook for further research. By the end of the third period, students were suggesting ways to reduce their contributions to smog—and recognizing some sources the Air Pollution Authority had not considered. In addition to reinforcing textbook concepts about oxidation and ionization, Jim realized that his students now understood the relevance and connections between high school chemistry and Los Angeles air.

Issue Investigation Example

When Karen Kenna assigned a research project to her sixth-graders, she was surprised by the high level of analysis and interest that one student showed. This student, Emily, had chosen animal testing procedures as her topic. The portfolio she turned in at the end of the term had letters to Colgate-Palmolive, Revlon, L'Oréal, and Ralston-Purina asking them about their animal testing policies—and responses from all of them. She had also collected information from an animal rights activist group. In Emily's report to the class, she presented what she had learned and what she had concluded and then asked her classmates to join her in boycotting certain products based on the companies' animal testing policies.

Karen took a summer course at Southern Illinois University where she learned an “issue investigation” process for helping her students explore issues and consider appropriate actions for resolving environmental problems. The instructors related several stories of student projects that demonstrated the degree of responsible investigation and action that can result from this process. Karen found that the issue investigation process had been well researched and evaluated, and that a curriculum with student handouts was available. These materials enabled her students to practice identifying issues and values, conduct an opinion poll, generate options for actions, and evaluate levels of action taking. One eighth-grader decided to investigate his county's illegal dumping activity. He sent a questionnaire to each county commissioner and asked them to identify illegal dumps on a map. Then he visited each site to record the types of waste that were being dumped. His report, with photographic evidence, was submitted to the county board and published in the local papers.

Now Karen lives in Virginia, and her new students are busy exploring their local environment (the Chesapeake Bay area) and developing issue investigation skills. With some topics, Karen brings information for them to analyze; at other times, the students choose their own issues to investigate.

An Interdisciplinary Team Example

Visiting a nearby country school, the sixth-grade class from Asheville, North Carolina, found the dilapidated setting unfamiliar and a little threatening. The feeling was stronger when they smelled the reeking Pigeon river and saw the sign: "Warning: Dioxin." They strolled along the river and listened to a rap on problems in the host school's community, particularly about how an upstream paper mill had changed the Pigeon River and its surroundings.

The project these students were engaged in, which might have been simply a casual exploration of a different locale, was actually part of a 12-week interdisciplinary unit designed to make each student an expert on papermaking, stream pollution, and toxic waste controversy. The unit was the product of four teachers who contributed concepts from their own subject areas. In science, students heard from a state official and toured a paper mill. In social studies, they examined the issue of toxic waste and discussed trade-offs between jobs and health and consumer convenience and the environment. They also examined library files and news articles and learned the importance of separating fact from opinion. In language arts, teachers organized tours, hosted speakers, and assigned interviews to provide students with practice in listening and note-taking. They required students to present oral and written reports based on specific readings; students also had to participate in a dialogue about toxic waste as part of their final exam. Students studied mathematics through stream sampling efforts, which required using formulae to calculate stream velocity and flow. For overnight field trips, students also developed personal budgets, recorded expenses, and managed their money.

The teaching team found that by focusing on an environmental theme, they were forced to create a new curriculum and plan activities that had components of each discipline. Throughout the implementation of this unit, the teachers made a point of not differentiating between subject areas. But, during the planning phase, each of the teachers represented his or her discipline and had two clear-cut responsibilities: to make sure that the content and skills from each subject were developed during the unit and to provide suggestions as to how this might be accomplished. Although this approach required some extra effort, the team found that the project unfolded so successfully that it inspired a movement to change the entire middle school program to one organized around thematic units and team teaching.

Five Approaches to Integration

1. What are the similarities between the approaches? What are the differences?
2. What are the advantages of each approach to the school system, the teacher and the student?
3. How might each approach be implemented in your school system?

Five Approaches to Integration

Project Approach: Content Process Pros and Cons

Thematic Approach:

Content Approach:

Issue Investigation:

Interdisciplinary Team:

Five Approaches to Integration

	Content Objectives	Process Objectives
The Project Example Water Conservation	water cycle resource conservation calculation and data analysis comparison shopping	investigation determining consumer responsibility teamwork
	Features: – interdisciplinary opportunity for real-world skill-building – designed and led by teachers	
The Thematic Example Loons	Native American culture state geography aquatic habitat	graphing creative writing appreciation for nature
	Features: – multidisciplinary opportunity with real world connections – program can be lead designed by one teacher – each specific topic involves major research	
The Content Example Smog in Chemistry	molecular structures chemical reactions atmospheric chemistry	analyzing current issues research and synthesis communication skills
	Features: – minimal change to course content – maintains focus of a specific discipline – designed and led by teachers	
Issue Investigation	political process	research and analytical skills application of values communication skills decision making skills
	Features: – interdisciplinary opportunity for real-world skill building – teacher designs skill-building; students design investigation – emphasis on student skills and initiative	
Interdisciplinary Team	toxic waste production process economic issues calculation and data analysis	research and analytical skills presentation techniques persuasive writing project planning/design
	Features: – diverse team provides expertise on several subject areas – theme approach downplays discipline boundaries – requires planning and system support	

Trainer Reference Materials

Avoiding Infusion Confusion: A Practical Handbook for Infusing Environmental Activities Into Your Classroom. Harvey Hayden, Marcie Oltman, Richard Thompson-Tucker and Sonya Wood, 1987. A four-volume set: K-3, 4-6, 7-9, 10-12. A reference guide for choosing activities from 7 commonly used EE instructional manuals that help convey basic ecological and EE concepts. Available for \$5 per book from:

Central Wisconsin Environmental
Education Station
7290 County MM
Amherst Junction WI 54407
☎ 715 824-2428

A Guide to Curriculum Planning in Environmental Education. David C. Engleson, 1994. A manual for teachers and school districts that introduces and explains EE, value development relevant teaching methods, and a process for infusing environmental topics into the existing curriculum. For availability, contact:

Wisconsin Department
of Public Instruction
125 South Webster Street
PO Box 7841
Madison WI 53707-7841
☎ 800 243-8782

"More Infusion Confusion: A Look at Environmental Education Curriculum Materials," Deborah Simmons, 1989. *Journal of Environmental Education*, 20 (4): 15-18. The author evaluates several popular environmental education (EE) instructional materials and concludes that the failure to infuse EE equally through out the curriculum may be related, in part, to the types of materials that are available.

"Sierra Club Petition to Congress Protesting the Proposed Diminution of Yosemite National Park," Richard Blondo and Wynell Burroughs Schamel, 1993. *Social Education*, 57(3): 131-132. The authors present an example of how a petition by the Sierra Club to Congress can be taught as social studies, history, politics, a research topic, economics, and environmental studies.

See also the following two articles in the EE Reference Collection:

"Courting Controversy: How to Build Interdisciplinary Units," Jackie Williams and Terry Deal Reynolds. *Educational Leadership*. pp. 13-15. (April 1993)

"Environmental Education in the K-12 Curriculum: Finding a Niche," John M. Ramsey, Harold R. Hungerford, and Trudi L. Volk. *Journal of Environmental Education*, 23:2, 35-45. (1992)

Teacher Materials for Content Infusion

Connections (1980). An assortment of activities that teach appropriate technologies for energy, transportation, and waste disposal in the U.S. Lessons, handouts, graphics, and quizzes make it easy to use and learn from. Available for \$7.00 from:

National Center for Appropriate
Technology
Box 3838
Butte MT 59702
☎ 406 494-4572

For Earth's Sake: Lessons in Population and the Environment. Deborah E. Brouse and Pamela B. Wasserman, 1989. Seventeen activities, a world reference population data chart, and other resources make up this middle school teaching kit. It focuses on the interconnectedness between people and the environment, while promoting a sense of individual responsibility for stewardship of our Earth. Available for \$24.95 from:

Zero Population Growth
1400 16th Street, NW
Washington DC 20036
☎ 202 332-2200

Earth Matters: Studies for Our Global Future. Pamela Wasserman and Andrea Doyle, 1991. A collection of readings and activities for secondary students that discuss the connections between environment quality and development, poverty, population, economics, and potential solutions. Available for \$19.95 from:

Zero Population Growth
1400 16th Street, NW
Suite 320
Washington DC 20036
☎ 202 332-2200

Keepers of the Animals. Michael Caduto and Joseph Bruchac, 1991. Fulcrum Publishing, Golden, Colorado. Also available: *Keepers of the Animals Teacher's Guide*, *Keepers of the Earth*, and *Keepers of the Earth Teacher's Guide*. Collections of Native American stories and ecological activities for young people that help explain concepts about wildlife and the environment.

Living Lightly on the Planet for Grades 7-9 and 10-12, Maura O'Conner (1985); **Living Lightly in the City for Grades K-3 and 4-6**, Maura O'Conner and Kathy McGlaufflin (1983, 1992). Background information and teaching activities that help students understand the connections that maintain ecosystems. Published by and available for \$19 each from:

Schlitz Audubon Center
1111 East Brown Deer Road
Milwaukee, WI 53217
☎ 414 352-2880

Project Learning Tree: Environmental Education Pre K-8 Activity Guide. Co-sponsored by the American Forest Foundation and the Western Regional Environmental Education Council, revised 1993. Focuses on the total environment: land, air, and water. Though revised, the curriculum remains easily adaptable to many settings from the classroom to youth organizations, museums, nature centers, and scout troupes. Nearly 100 activities are offered in a storyline technique covering the themes of diversity, interrelationships, systems, structure and scale, and patterns of change. Central to the new curriculum is an emphasis on constructivist learning theory and whole language teaching strategies. Background information, authentic assessment opportunities, an extensive bibliography, and a cross-reference index are also included. A new 7-12 curriculum made up of individual thematic modules in near completion. Available only through workshop; contact PLT for the name of the PLT coordinator in your state:

Project Learning Tree
1111 19th Street NW Suite 780
Washington DC 20036
☎ 202 463-2462

Project WET. A national program that offers a variety of instructional resources for teachers on water topics and issues such as wetlands, water quality and quantity, groundwater resources, and aquatic habitat. Workshops will be available to help teachers utilize the materials. Call for availability and additional information:

Project WET
Culbertson Hall
Montana State University
Bozeman MT 59715
☎ 406 994-5392

Project WILD: Activity Guides for Grades K Through 12. Western Regional Environmental Education Council and the Western Association of Fish and Wildlife Agencies, 1985. The Project WILD Guide is a set of interdisciplinary activities based on wildlife, animal ecology, and the human connection to wild animals. A second guide, *Aquatic WILD*, focuses on water-related wildlife activities and issues. Each activity includes learning objectives, background information, and a list of suggested extension activities. Available only through teacher workshops; contact Project WILD for the name of the WILD Coordinator in your state:

Project WILD
5430 Grosvenor Lane
Bethesda MD 20814
☎ 301 493-5447

Teacher's Guide to World Resources 1992-93: Comprehensive Coursework on the Global Environment, 1992. Activities, graphs, and information in this booklet enhance the global data available in *World Resources 92-93*. Teachers can use these units on wetlands, biodiversity, citizen action, etc., to develop or enhance a secondary course or unit. Available for \$5.95 from:

World Resources Institute
1709 New York Avenue, NW
Suite 700
Washington DC 20006
☎ 800 822-0504

USA by Numbers. Deborah E. Brouse and Susan Weber, 1988. Fourteen activities to accompany the 150-page book of statistics on the United States demographics of states and major cities, life expectancy and age distribution, fertility and birth rates, teen pregnancy, unemployment, poverty, water use, air pollution, waste streams, and habitat loss. Available for \$19.95 from:

Zero Population Growth
1400 16th Street, NW
Washington DC 20036
☎ 202 332-2200

Teacher Materials for Process Infusion

The Action Research and Community Problem Solving Manual. William B. Stapp et al., 1994. The theory behind an action research and empowerment model of teaching problem-solving skills, several classroom case studies, and a step-by-step guide for beginning a similar program. For information contact:

GREEN
721 E. Huron Street
Ann Arbor MI 48104
☎ 313 761-8142

Environmental Problem Solving: Theory, Practice, and Possibilities, by Lisa Bardwell, Martha Monroe, and Margaret Tudor, 1994. A monograph that describes the research in cognitive psychology that helps understand the problem-solving process, explains four EE models of teaching problem solving, and discusses the strategies that practitioners have developed to teach or practice problem-solving skills. Includes sample activities that help build problem-solving skills. Available from:

NAAEE
PO Box 400
Troy, OH 45373
☎ 513 698-6493

Global Teacher, Global Learner. Graham Pike and David Selby, 1988. Hodder and Stoughton, London. A thorough and readable treatment of activities and ideas for enhancing student learning and problem-solving abilities, adapting curricula, and altering the classroom environment.

Human Resource Development Set.

J. William Pfeiffer, 1987-93. Now a set of 22 volumes and over 250 structured experiences for building skills in conflict resolution, decision making, values clarification, group process, leadership, communication, consensus-seeking, team building, etc. Written for adult professional development training. To order, contact:

Pfeiffer and Company
8517 Production Avenue
San Diego CA 92121-2280
☎ 800 274-4434

Investigating and Evaluating Environmental Issues and Actions. Harold R. Hungerford, Ralph A. Litherland, R. Ben Peyton, John M. Ramsey, Audrey N. Tomera, and Trudi L. Volk, 1985. Stipes Publishing, Champaign, Illinois. A series of modules and activities that develop students' skill in investigating and evaluating problems. To order, contact:

Stipes Publishing
10-12 Chester Street
Champaign IL 61820

The Kid's Guide to Social Action. Barbara A. Lewis, 1991. Free Spirit Publishing, Minneapolis, Minnesota. Examples, skills, and concrete suggestions for exploring local issues and taking action.

Training Student Organizers Curriculum, by Michael Zamm, Robert Ortner, and Beverly DeAngelis, 1990. Trains students to organize environmental improvement projects in schools and neighborhoods. Available for \$15 from:

Council on the Environment of NYC
Attention: Michael Zamm
51 Chambers Street, Room 228
New York NY 10007
☎ 212 788-7900

ENDNOTES

- 1 JOHN GOODLAD, 1984. *A Place Called School: Prospects for the Future* (Chapter 4). New York: McGraw-Hill.
- 2 DAVID ORR, "What is Education For?" *Clearing*, No. 80, September/October 1993.
- 3 GOODLAD, 1984. pp. 55-56.
- 4 Bob Samples, Bill Hammond, and Bernice McCarthy. 1985. *MAT and Science: Toward Wholeness in Science Education*. Barrington, Ill.: EXCEL, Inc.
- 5 Even this is not a universal definition of infusion and insertion. Ramsey et al. (1992) use the term to distinguish between teacher-prepared explorations of an issue empha-

sizing content learning (infusion) and investigation of student-chosen issues in which the focus is on skill building (insertion).

JOHN M. RAMSEY, HAROLD R. HUNGERFORD, AND TRUDI L. VOLK, "Environmental Education in the K-12 Curriculum: Finding the Niche," *Journal of Environmental Education*. 23(2) (1992):35-45.

- 6 PROJECT WILD activities, for example, are used primarily within science classes.

DEBORAH SIMMONS, "More Infusion Confusion: A Look at EE Curriculum Materials," *Journal of Environmental Education*. 20 (4) (1989):15-18.

N C E E T

National Consortium for
Environmental Education
and Training