A RATIONALE AND SUGGESTED FRAMEWORK FOR AN ENVIRONMENTAL EDUCATION ACTIVITIES SUPPLEMENT FOR THE 1981 MODERN BIOLOGY TEXTBOOK

by

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ABSTRACT

The purpose of this research was twofold: Firstly, to establish a rationale for the development of a supplement of environmental education activities for the Holt, Rinehart and Winston 1981 Modern Biology textbook by Otto, Towle and Bradley. This rationale was based on the location of and the means by which environmental education is commonly treated within the formal school system. The second purpose was to offer suggestions, recommendations, and examples of the elements which the proposed supplement should contain. This included sample activities and sample reference materials designed for a specific unit in the Modern Biology text.

It is the author's intention that this paper serve as the first step in the actual development of such a supplement and that hopefully, further research will be conducted to insure its completion.

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CHAPTER I

INTRODUCTION

> We abuse land because we regard it as a commodity belonging to us. When we begin to see it as a community to which we belong, we will learn to use it with love and respect.
>
> Aldo Leopold

There is a limit as to how much modification our ecosystem can withstand. Overpopulation is the cause of many of our environmental problems. It has accelerated the consumption of our already dwindling supply of natural resources and is responsible for gross amounts of environmental pollution. Our survival in the face of these environmental crises is dependent upon an economy which is productive in maintaining or increasing the quality of life, but not at the cost of our natural environment which serves as our life support system (Studebaker, 1973).

Irreversibility implies permanency. It is another way of saying "you can't go back". The fact that many of man's activities have been responsible for irreversible impacts on the environment is undeniable. Examples of these impacts were included in a report to the President entitled "Global 2000":

> The world's forests are now disappearing at the rate of 18-20 million hectares a year (an area half the size of California), with most of the loss occurring in the humid tropical forests of Africa, Asia and South America. The projections indicate that by the year 2000 some 40 percent of the remaining forest cover in lesser developed countries will be gone.
>
> Deterioration of agricultural soils will occur world-wide, due to erosion, loss of organic matter, desert-

> ification, salinization, alkalinization and water-logging. Already, an area of cropland and grassland approximately the size of Maine is becoming barren wasteland each year, and the spread of desert-like conditions is likely to accelerate.
>
> Extinctions of plant and animal species will increase dramatically. Hundreds of thousands of species--perhaps as many as 20 percent of all species on earth--will be irretrievably lost as their habitats vanish, especially in tropical forests.

Once these precious resources disappear they are virtually lost forever. This damage is irreversible, for once it occurs there is no going back. Life will become more precarious as the years roll by. If the present and projected growth rates hold true, our planet may have to sustain life for 30 billion people by the end of the 21st century.

Is it too late to stop the momentum? It may very well be too late, but there may be ways to slow or alter its direction. One way this could be achieved is through intelligent decision-making, a skill that can be acquired through environmental education. The Global 2000 report to the President concluded that new initiatives are needed if worsening poverty, human suffering and environmental degradation are to be prevented. Environmental education must respond to this challenge.

Before 1970, education about the environment had several different titles. It was labeled conservation education, nature studies, outdoor education and ecology. Although some overlapping existed, most of these disciplines had their own set of goals and philosophies

(Troy & Schwaab, 1982). Environmental education may embrace many of these studies, but involves a great deal more.

Environmental education is not simply nature study nor is it solely the study of conservation or ecology. It is a many-faceted discipline which looks at the total environment of man. For example, in the study of ecology, one of the basic principles is that "everything is connected". Ecology serves to explain how this process works. Although environmental education may begin with these basics, its purpose is to make the connections between ecology and the environment (Tanner, 1974).

The trend in defining environmental education is to synthesize the fragmented disciplinary modes of thinking (Troy & Schwaab, 1982). Schoenfeld (1970) in an all-encompassing definition, sees environmental education to be made up of five components. The first is that it should look at the pressures being placed on the environment from the great increase in population; secondly, it should attempt to look at the interactions between man and the environment, rather than focusing on one or the other; third, environmental education should be interdisciplinary--in other words, it should include a variety of academic disciplines; fourth, it should seek long-term, ecologically-sound solutions to environmental problems, rather than those that are quick, simple and short-term; and fifth, the end goal of environmental

education should be the development of an environmental ethic.

Stapp describes environmental education as

> a process aimed at developing a world population that is aware of, and concerned about the total environment and its associated problems, and which has the knnowledge, attitudes, motivations, commitments and skills to work individually and collectively towards solutions of current problems and the prevention of new ones.

Formal environmental education is still very young. As environmental problems grew in proportion, so did the awareness and concern of citizens. Finally, about 1970, educational institutions, as well as business organizations and other groups, began to focus many of their activities towards increasing peoples awareness about environmental issues (Rillo, 1974). Although a step in the right direction, awareness by itself did not provide solutions. What was and still is really needed are citizens who are not only aware but are also motivated and willing to donate their time and energy to seeking solutions to environmental problems.

Since its beginnings, environmental education has grown in sophistication. Since its origin, environmental educators have attempted to assist people in becoming environmentally literate. Environmental education now stands on a foundation of structured goals and objectives, developed by such leaders in the field as Hungerford, Peyton and Wilke (Appendix A). These goals and objectives provide clear directions for developing environmental

literacy. Only in recent years have we really begun to consider who should have the responsibility for developing environmentally literate citizens and where environmental education should be taught.

At present, there are many institutions and organizations involved in environmental education. Examples of these are: government; business and industry; agriculture; instructional and commercial media; labor, civic, religious, fraternal and service organizations; youth and student groups; universities and colleges; and perhaps most importantly, elementary and secondary schools. The literature has indicated that the best avenue for achieving the goals of environmental education is through the education system (Rillo, 1974).

Stapp (1979) claimed that the majority of efforts to provide environmental education in the U.S. have been focused on formal education. The environmental education efforts that are currently being made are primarily found at the pre-college level. More specifically, they are found within the secondary school and are generally the responsibility of the science teacher. Expanding on this Hungerford and Peyton suggested that

> the science teacher has been given the responsibility for environmental education for a number of reasons. Among them is the equation of ecology with environmental education. Similarly, science teachers probably feel more comfortable with this topic than their peers and administrators quite naturally look toward science people for leadership in this area. (1976, p.2)

Because environmental education is often associated and

many times equated with ecology, it is found where ecology is most often found--within the biology classroom.

It is of benefit to consider that there are exceptions. Many schools may have a specific course or courses in which environmental education is taught, such as ecology, conservation or environmental studies. However, this paper focuses on the most common method of providing environmental education to students, which is to incorporate it within the biology curriculum as a component of ecology.

It has been stated in the literature that the science of ecology is devoted to studying organisms and their interaction with the environment (Bluhm, 1975). It has also been determined that ecology is an integral component of environmental education (Dowdeswell, 1974; Hungerford & Peyton, 1976; and Kupchella & Hyland, 1977). Yet ecology alone is not environmental education. It seems imperative that biology teachers also apply the principles of ecology to the understanding of environmental problems and issues (Barber, 1980).

If environmental education is to be examined as it is taught in the biology classroom, the best approach may be to look at the curriculum materials used in biology instruction. Studies have determined that textbooks hold the dominant position in learning experiences (Harms & Yager, 1981). A report developed by Weiss in 1978 focused on teacher dependency on biology textbooks. It revealed

that more times than not, the textbook is the primary source of curriculum--and sometimes the only resource used in biology instruction (DeHart Hurd, Bybee, Kahle & Yager, 1980). Therefore, a logical question might be how much environmental education is contained within commonly used biology textbooks and how well does the material satisfy the goals and objectives for environmental education.

In a review of five widely used biology textbooks, the researcher found that although each text adequately covered the topic of ecology, they contained little else that could be labeled as environmental education. That which was incorporated in these texts did not satisfy the widely agreed upon definitions of environmental education, nor did it properly address the goals and objectives of environmental education (Appendix A).

The author understands that biology and all sciences do have their own goals which must be considered. Therefore, it seems logical to examine today's goals of science education.

In looking at science curricula needs for the 1980's, Perrott (1980) emphasized that future science teaching should "go beyond the restrictive context of the special disciplines and consider science in relation to the affairs of mankind.... knowledge lacks significance unless it can be applied to problems or used to seek new goals". Other authors reinforce the urgent need for applying the scientific principles and knowledge taught in the biology

classroom to everyday problems or crises in our environment.

By infusing well-implemented environmental education curricula into the biology program, we can more successfully address these present and future goals of science education. In the process, we will also be developing environmentally literate students who will be able to better cope with decisions concerning the future of our environment.

Keach (1973) pointed out that

> if new curriculum projects provide viable conceptual frameworks, are action-oriented, and focus upon the development of inquiry and decision-making skills, they will serve as excellent catalysts for encouraging students to work toward the environmental quality necessary for a productive and satisfying life.

Rillo (1974) feels that if conducted in the right way, environmental education may be successful in prompting young people to do something positive in turning around the negative aspects of the environmental predicament.

The evidence has shown that environmental education has been relegated to the biology teacher, and that the textbook, as the most widely used source of existing curricula, exhibits inadequate treatment of the necessary components of environmental educaiton. The need for making biology education a socially relevant experience for students has also been recognized.

If one accepts these premises, it can be concluded that there is a need for developing supplemental curriculum materials which make biology more socially relevant by

addressing the essential goals and objectives of environmental education.

Rillo (1974) has said "environmental education for all students could very well be the greatest contribution education has ever made to the family of man". By incorporating environmental education into biology classes a very large percentage of our students could be provided with the knowledge and skills necessary for them to become environmentally literate.

Therefore, it is the researcher's purpose to develop a framework for the design of an environmental education activities supplement to be used with the most widely used high school biology textbook in the nation, MODERN BIOLOGY, by Otto Towle and Bradley.

CHAPTER II

ENVIRONMENTAL EDUCATION-- WHAT IT IS, WHERE IT'S FOUND, HOW IT'S TREATED

There are many things to consider in the establishment of a framework for an environmental education supplement for the MODERN BIOLOGY text. The first of these is the rationale for the necessity of such a supplement.

The aim of this chapter is to provide the reader with an accurate description of environmental education, its treatment within the school system and its inclusion within the biology curriculum. Also addressed is the need to bring social relevance to biological education and the suggestion that environmental education can provide for this need. A definition which distinguishes between the study of environmental education and ecology can be found in this chapter. A review of popular high school biology textbooks concerning their treatment of environmental education is also presented within this chapter.

WHAT ENVIRONMENTAL EDUCATION SHOULD BE

In past years environmental educators faced the problem of defining what environmental education is and what it is not (Troy & Schwaab, 1982). Due to the combined efforts of many professionals in the field, it has been stated that environmental education now rests on a substantive structure (Hungerford, Peyton & Wilke, 1983). Environmental education was frequently used as a catch-all term for any type of education which deals with the natural

environment. It involves the total environment of man, which consists of biological, social, economic, cultural, ethical and aesthetic components of the environment (Rillo, 1974). This lack of specificity and/or broadness of scope produced a certain amount of confusion when defining environmental education. As a result, several myths have evolved concerning the actual meaning of this discipline.

One of the most common myths of environmental education is that it is synonymous with the fields of ecology, conservation and outdoor education. Perhaps if each of these areas were defined at this point, the differences may be more clearly revealed.

Conservation education is that field which deals with the "wise use of natural resources". It is education which is concerned with predetermined resource use (or fixed) management practices (Hungerford & Peyton, 1976, p.3). Outdoor education has been defined as the effective utilization of resources (including human) beyond the classroom to enhance and enrich teaching and learning (Fitzpatrick, 1968). Ecology, on the other hand, is the science that empirically investigates the interrelationships that exist between organisms and their environment. Its purpose is to allow scientists a means for investigating an organism in the context of that organism's environment (Hungerford & Peyton, 1976, p. 46). A very succinct definition of environmental education is given by Hungerford & Litherland (1975). It illustrates the

multifaceted nature of this field of study:

> Environmental education is that aspect of man's education which deals with culturally-imposed, ecologically-related problems in man's environment...further, the acquisition and application of human values as related to the cultural use and misuse of biotic and abiotic resources.

There is little doubt that a great deal of overlapping occurs between conservation, outdoor education and ecology, yet environmental education stands out among the rest because it focuses on people's values and their ability to make decisions. Rillo (1974) describes conservation education and outdoor education as a chrysalis from which environmental education arose. He claimed that environmental education has grown out of the need for a "long view of environmental problems and consideration of the history of human populations in relation to natural and cultural resources, their present predicament and their future outlook".

The Wisconsin Environmental Education Council stated another reason why environmental education should not be confused with these other related disciplines. They interpreted environmental education as a broader approach concerning the capacity for urban, rural, natural and man-made habitats to meet the challenge of human survival (WEEC, 1974).

The descriptions of environmental education are highly variable. In reviewing the literature, the researcher attempted to compile those definitions and descriptions of environmental education which are most widely agreed upon.

This compilation is intended to serve as a thorough account of what environmental education should entail.

A well-accepted definition of environmental education was devised by Stapp in 1974. According to Stapp, environmental education is one method to

> develop a citizenry which is knowledgeable about the biophysical environment and its associated problems, and is aware of how to become effectively involved in working towards the development of a more livable future and is motivated to do so.

The idea of producing a more "livable future" through awareness is seen by many to be the most critical approach. This concept arises time and again when reviewing literature describing those elements which environmental education should contain. This idea is also reinforced in Harvey's Superordinate Goal of Environmental Education (1977):

> to aid citizens in becoming environmentally knowlegeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between the quality of life and the quality of the environment.

If harmony is to exist between the economic, political, social, cultural and aesthetic segments of man's society and the natural environment, then environmental education should serve as the learning process that encompasses all of these systems through formal and informal approaches (WEEC, 1974).

Similar ideas as to what environmental education should involve were seen within the Belgrade Charter, a product of the 1976 UNESCO-UNEP International Environmental

Education workshop. This charter stated that environmental education should provide the "knowledge, skills, attitudes, motivation and commitment to work...toward solutions of current problems and the prevention of new ones".

Parallel to these descriptions of environmental education was that which was included within the Tbilisi Report (1977)--a document developed as a result of the world's first Intergovernmental Conference on Environmental Education. It stated that environmental education should

> succeed in making individuals and communities understand the complex nature of the natural and built environments resulting from the interaction of their biological, physical, social, economic and cultural aspects, and acquire the knowledge, values, attitudes and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and in the management of the quality of the environment.

Specific categories of objectives for environmental education were identified in the report and twelve guiding principles were established for these objectives (Appendix B). It was maintained that through the use of these principles and guidelines, environmental education would hopefully succeed in revealing the continuity which links the acts of today to the consequences of tomorrow, therefore making a powerful contribution to renovating the educational process (Tbilisi, 1977).

The Tbilisi Conference made it apparent that in order to have any kind of structure for a program of environmental education it is necessary to establish a foundation built upon goals and objectives. Although a

variety of general goals for environmental education were compiled as a product of the conference, it was found that more specific goals were needed. As a result of the information within the Tbilisi Report and as an elaboration of Harvey's Superordinate Goal of Environmental Education, Hungerford, Peyton and Wilke (1980) designed the Goals for Curriculum Development in Environmental Education (GCDEE). These goals were validated by a panel of distinguished environmental educators. They were developed for use by educators in designing curricula within formal and nonformal settings. A program of environmental education should contain these goal levels which together will act as a sound framework which can serve in achieving the Superordinate Goal. These goals are divided into four levels for which there are individual conceptual components (Appendix A). The achievement of each of the four levels of goals should result in environmentally literate students.

The first level of the Goals for Curriculum Development in Environmental Education is the Ecological Foundations level. It is an essential prerequisite for the other levels because it provides the student with the necessary foundation or knowledge base for eventually making sound decisions concerning environmental issues. It is crucial to have a basic understanding of how the environment is affected by human impact. It has been stated that in order for environmental literacy to be

achieved, the knowledge of ecological principles and how they apply to man-environment interactions must be acquired (Hungerford & Peyton 1976, p. 46). In looking at basic guidelines for environmental education, Rillo (1974) determined that if a child is to gain any understanding of today's environmental problems, he/she must have an understanding of the interrelationships between biotic and abiotic factors within the natural and man-made environment and man's place within these settings. However important this goal level, by itself it will not succeed in the production of students ready for decisionmaking and problem-solving.

The second level--Conceptual Awareness of Issues and Values, attempts to make the student aware of how his/her actions can influence the balance between a healthy life and a healthy environment. It enables the student to understand how these actions can result in creating an environmental issue, as well as discovering ways in which these issues can be resolved. It examines the methods of values clarification, investigation and evaluation, decision-making and action-taking--all important avenues in resolving environmental problems.

As Keach (1973) pointed out, many environmental education programs are "awareness-oriented". In a 1978 study Childress found that this still remained the case in public school environmental education curricula. He felt that little attention was given to objectives which

fostered problem-solving skills. The third level of the GCDEE is the Investigation and Evaluation level. This level is concerned with providing students with the necessary knowledge and skills for actually investigating and analyzing environmental issues; for making decisions and seeking alternative solutions; and for evaluating and perhaps changing or modifying their own value positions after obtaining the information.

Level four is the Environmental Action Skills Training and Application level. It seeks to provide the student with the skills necessary to take positive environmental action. It acquaints the learner with various categories of action strategies. Included are methods such as persuasion, political and legal action and ecomanagement. This level makes the student aware of the various levels at which an issue can be influenced--that is, from individual to large organizational levels. It also provides usable criteria for analyzing one's decisions concerning the choice of action strategies. The results of a 1980 study by Ramsey, Hungerford and Tomera revealed that citizen participation in problem-solving concerning environmental issues could very likely be achieved by incorporating environmental action instruction into the school curriculum.

Key characteristics and components that are necessary within environmental education were developed by Hart (1981) who claimed that through clarifying components and

important characteristics, understanding of broad systems can be facilitated by making ideas that may seem vague, more precise and intelligible. He states that these can make more concrete definitions which provide better detailed guides on how to operate and implement programs of environmental education. As a result, Hart identified 25 key characteristics of environmental education which could serve as structural elements in curriculum planning and instruction (Appendix C).

If environmental education curricula, such as the MODERN BIOLOGY supplement proposed by the researcher, is developed via the use of a sound framework of goals, objectives, and guidelines, it should succeed in achieving the Superordinate Goal of Environmental Education--to produce students who are environmentally literate. The responsibility for the development of an environmentally literate citizenry rests within the school system, and it is significant to note that this is generally laid in the lap of the biology teacher (Wilson & Tomera, 1980).

ENVIRONMENTAL EDUCATION IN THE SCHOOLS

A number of authorities have called attention to the importance of incorporating environmental education into the schools. Nineteen references were used to support a statement by Tanner (1974), that "there is wide agreement that environmental education must be integrated into the existing curriculum at all grade levels and in all

subjects". The school provides the best opportunity for students to acquire the theory and knowledge of environmental education (Moroni, 1978).

In looking at specific approaches to environmental education, Rillo (1974) feels that one approach should involve a location where the most people can be reached. He feels the private and public schools are the source of the greatest potential for environmental education. Moroni (1978) also feels very strongly about environmental education having its place within the formal educational system. He believes it can teach students those skills which will be necessary for responsible decision-making and for constructively interpreting both the natural world and the society in which the students live.

Studebaker (1973) indicated that there is sufficient scientific, historical, philosophical, sociological and political justification for the existence of environmental education in the schools. He expressed the idea that environmental education should be treated as a way of life and should be dealt with in the schools as other ways of life are, such as democracy and patriotism.

The placement of environmental education within a particular grade level range is somewhat variable. Although there has been wide agreement for incorporating environmental education into all grade levels and courses, it is usually found at the secondary level, isolated within a single course (Tanner, 1974). As a result, the greatest

efforts in designing and implementing environmental education curricula have been found to be made at the upper elementary and senior high levels (Childress, 1978).

Numerous suggestions have been offered concerning the design for curriculum writing efforts for environmental education in the schools. The Tbilisi Report recommended that primary schools design their environmental education curriculum to allow students close contact with their environment and to enable them to view things holistically, therefore promoting an awareness of the relationship between themselves and their environment. The report also suggested that secondary school curricula should seek to expand the pupils understanding of the environment by identifying the relationship between the natural world and the human society. It should give students the opportunity to explore environmental issues from several different angles.

Another suggestion promoted the design of curricula which was built on viable conceptual framework and which encouraged students to work for environmental quality through the design of activities that are action-oriented and that serve to develop inquiry and decision-making skills (Keach, 1973).

In addition to those mentioned, many other suggestions for curriculum design in environmental education can be found in the literature. But although the ideas are widely available, and many efforts to design curricula have been

made, the documentation of overall trends or characteristics concerning existing environmental education curricula is very sparse. This is related to a variety of factors, all of which are responsible for inhibiting the overall effectiveness of environmental education curriculum efforts within the public schools (Childress, 1978). McInnis (1972) reinforced this idea when, in illustrating some general trends in environmental education curricula, he found that many extremes occur between viewpoints of what environmental education curricula should contain. For the most part, educators accepted the viewpoint that environmental education curricula should pervade all forms of study rather than be dealt with as a separate concern. This viewpoint resulted in a great deal of confusion as to where environmental education belonged within the schools.

Although there is a great deal of support for the justification of environmental education within the school system and many efforts have been made towards the design of appropriate curricula, the proper location of environmental education among the various disciplines within the secondary school remains uncertain. Most studies have indicated that environmental education is isolated within the science curriculum. The classes in which environmental education is taught most frequently are those dealing with the natural sciences, followed by social and physical sciences (James & Potts, 1978). The results of a study by Hepburn, Shrub and Simpson (1978) revealed that

the use of science over social studies as a basis for teaching environmental education was more influential in producing positive environmental attitudes. Although significant, this is not the primary reason environmental education efforts have been concentrated in the sciences. One of the essential characteristics of environmental education is seeking and choosing alternatives to particular situations. Science is involved with a great deal of manipulation of variables and can therefore serve as the best subject area to contribute to the development of this characteristic (Lucas, 1980). Further, the most widely accepted belief is that the only way to understand man's environment is by the use of science as a basis (McMichael & Strom, 1975).

ENVIRONMENTAL EDUCATION IN BIOLOGY

The next logical question to be raised might concern the selection of a particular science class for the inclusion of environmental education. It has been claimed that since environmental education deals with the relationship between man and his environment, it is fundamentally biological (Lucas, 1980). It was found that 92% of the curricula in environmental education used biology as an important source of content (Childress, 1978). The literature states that if environmental education is taught within a school system, the responsibility is usually given to the biology teacher.

With this in mind, the number and grade level of students which take biology needs to be considered.

In a comprehensive study of biology education in the secondary schools, it was revealed that

> biology is the most frequently offered science in the secondary school program. It is usually offered as a tenth grade course. General Biology is offered in 95% of the schools and serves over 80% of all students enrolled in the nations' secondary schools (DeHart Hurd, Bybee, Kahle & Yager, 1980).

Since it has been established that environmental education is often taught within the biology classroom and that most students usually enroll in this course as a tenth-grader, it follows then, that biology may very well be the last science course many of the students will ever have. According to Bybee (1979), "Eighty percent of students take no science after tenth grade and here the science taught is usually biology. So, high school biology is the terminal science course for the majority of students". Eighty percent constitutes about 3 million students (DeHart Hurd, et. al., 1980).

Taking these figures into consideration, it appears as though many times the only encounter a student will have with environmental education is that which they receive in their high school biology course. It seems imperative that the biology curriculum devote the appropriate attention to environmental education.

ENVIRONMENTAL EDUCATION AND SOCIAL RELEVANCE

The fact that science education is under fire to be

socially relevant can no longer be ignored. Many leaders in science education are calling for a new biology curriculum which incorporates the social problems and ethical dimensions of the field (Harms & Yager, 1981; Dehart Hurd, et. al., 1980; and Levin & Lindbeck, 1979).

Emphasis on the interaction of science and society should be a major goal in science education. Those involved with science education must not only convey the basic body of scientific knowledge, but must also interpret societal influence on science and vice versa (Yager, Hofstein & Lunetta, 1980). The infusion of environmental education into biology can bring social relevance to the biology classroom.

Project Synthesis, an extensive research effort funded by the National Science Foiundation, examined pre-college science education and made basic recommendations regarding future directions for science education. This report stated that science education should "prepare individuals to utilize science for improving their own lives and for coping with an increasingly technological world". It indicated that this could be done through preparing students to deal with science-related societal issues.

The schools have been given the responsibility for teaching students the necessary techniques to not only interpret their natural world and the society in which they live, but also to make responsible decisions regarding these areas (Moroni, 1978). The researcher herself has

been faced many times by students in science classes asking about the worth of it all and wondering what value this information would hold for them in the future. The time seems more ripe than ever for making the science class a socially relevant experience for students. By incorporating environmental education into the biology classroom we can bring this relevance to the basic biological principles. This knowledge can be applied to the physical structure and characteristics of the natural and man-made environments in which the students live, and the associated problems and crises within these environments. The transfer value of this addition to the science curriculum cannot be overestimated, and should be especially emphasized within the biology classroom. Students are confronted each day with a variety of social and environmental problems and they should be able to study these problems from a biologic standpoint and then apply these processes to these problems (James, Schmidt & Conley, 1974).

Sonneborn (1972) saw the need to prioritize biological information on societal problems. He felt that this was necessary in preparing students to make future decisions concerning biological issues. The viewpoints of those researchers concerned with the incorporation of socially relevant issues into biology education can best be summarized by the following quote:

> Few deny the importance of contemporary problems; however, many fail to understand that even social, economic, and political problems are related to the

> fundamental problem of ecological scarcity. Contemporary social problems are too important to ignore because they are not clearly within the discipline of biology. They demand ore than the marginal recognition afforded by elective courses. Societal issues must be a primary focus of biology education (DeHart Hurd, et. al., 1980).

The literature illustrates that social relevance within biological education has been in great demand throughout the past decade and remains the basic thrust of biological education for the future.

The inclusion of environmental education into the curriculum can indeed fill this demand. A workable relationship with the environment is considered to be the foremost social need and should play an important role in guiding today's educational system (Studebaker, 1973). Science is seen as a vehicle for promoting environmentaleducation and, in turn, environmental education is viewed as a vehicle for demonstrating and interpreting the social relevance of science (Lucas, 1980). Goldstein and Lockwood (1980) are in agreement with this statement and have affirmed that environmental education offers students the opportunity to apply their skills to real-life situations, thereby extending their knowledge and problem-solving skills.

It follows then that if a primary goal for science curriculum is to enable students to better understand societal problems, it can be met by offering instruction via electives such as environmental education (DeHart Hurd, et. al., 1980).

ENVIRONMENTAL EDUCATION AND BIOLOGY CURRICULUM

It is the researcher's conclusion that environmental education should be offered as an integral component of the biology curriculum. If the biology class does provide one of the only occasions for a student to receive environmental education, it is necessary to examine its treatment within the biology curriculum.

In a recent survey of nationwide state departments of education, it was indicated that close to 90% of the states have developed some type of environmental education materials or courses for use within the schools (Troy & Schwaab, 1982). Unfortunately, many of these materials have lacked focus, philosophy and organization and tend to vary widely in scope (Hart & McClaren, 1978). This may have resulted in the findings that many biology teachers hesitated to "venture beyond the boundaries set by the instructional materials" (Stake & Easley, 1978). With this in mind it becomes necessary for teachers to use those instructional materials which will most effectively convey the fundamental principles of biology as well as the concepts of environmental education.

BIOLOGY CURRICULUM

The majority of times the curriculum used in biology instruction is that which is contained in the textbooks. It has been claimed that many times the course content is

so centered on the textbook that the text can almost be equated with the curriculum (Grobman, 1969). Stuart)1982) added that the material which is covered in the textbook stems from what the author deems essential. It appears as though the goals of the biology course are those that are in the textbook, so the text actually controls the content of the course (DeHart Hurd et. al., 1980).

A significant study was conducted by the National Science Foundation in 1980 concerning biology curriculum in secondary schools. This study revealed an amazingly high dependence on textbooks in determining science curriculum. These points are illustrated by the statements in Appendix D. McLaughlin (1981) labels this dependence "textbookitis" and defines it as

> the belief, sometimes a little more than vague feeling, that the tidy and convenient structure inherent in a textbook will transfer into the classroom and control the tremendous impulse toward chaos that realities of the classroom--discontented or confused students, inconvenient interruptions from the office, a frustrated teacher, Monday mornings--seem to have.

He feels that the cause of "textbookitis" stems from the security, comfort and convenience in having a neatly arranged curriculum.

If the content of the textbook is indicative of the material taught throughout the biology course, it is necessary to examine the manner in which environmental education is presented within the biology textbook.

BIOLOGY TEXTBOOKS

Harms and Yager (1981) found that up until 1979, there were virtually no existing textbooks which treated the relationship between basic science concepts and environmental/societal issues and problems. They recommended that not only teachers, but principals, curriculum committees and administrators all encourage textbook publishers to include these issues within their science texts.

Meanwhile, it appears that it is up to the biology teacher to make the effort to "expand the study of controversial issues beyond the limitations of the textbook by the use of well-prepared supplementary materials on societal problems" (Levin & Lindbeck, 1979). This statement strongly supports the need for supplemental environmental education materials for use within the biology classroom.

In order to design a supplement of this type, it is necessary to begin by looking at the basic format of the biology textbook. Five widely used biology texts were examined by this author to determine similarities in content and sequencing of biological concepts. The chart in Appendix E illustrates that these textbooks contain similar topics of study. Although slight variations do occur, the sequencing of the subject matter is somewhat consistent from one textbook to the next. It is significant to note that the majority of these textbooks place ecology within the last section of the book. Otto, Towle and Bradley (1981), authors of MODERN BIOLOGY, felt that this was the

logical location for ecology within the text because they viewed it as a "filling climax and final overview" to the rest of the biology course. Yambert (1980) stated that since the 1950's there has been an increase in demand for placing ecology as well as environmental education in the biology textbook. He feels that this may have resulted in tacking it onto the end of the book, while retaining the same content throughout the text from one year to the next. This provided a convenient method for incorporating ecology into the text and became a trend with publishers.

From the researcher's own observations while in the teaching field and via supporting statements from Barber (1980), it can be stated that it is not uncommon for teachers to squeeze the teaching of ecology into a few weeks or less at the end of the school year. This doesn't necessarily reflect a lack of interest in the subject matter, but perhaps a lack of instructional time. Dowdeswell (1979) stated that "the fact remains that even now, with environmental problems looming so large, ecology in many schools tends to be crammed into an insignificant corner of the curriculum occupying the last week or so". Nonetheless, teachers remain under constant pressure to cover the majority of concepts dealt with throughout the bulk of the text. This pressure is understandable when one considers that a teacher may have 180 days or less in which to communicate the material contained within a seven or eight-hundred page textbook.

ECOLOGY VERSUS ENVIRONMENTAL EDUCATION

A common myth is that ecology and environmental education are one in the same. According to Bluhm (1975) and Hungerford and Peyton (1976), many people believe that environmental education is the science of ecology. The two has very distinct definitions. Ecology has been defined as study of "the interrelationships that exist between organisms and their environment". Environmental education uses ecology as a foundation but also incorporates such elements as environmental issues, value perspectives, issue investigation skills, decision-making skills and the applicatin of citizen action strategies (Hungerford, Peyton & Wilke, 1980). If one of the major goals of environmental education is to develop environmentally literate citizens, it is essential to address the fundamental principles of ecology. This premise is supported by many researchers in environmental education (Bogan, 1973; Booth, 1979; Hungerford & Peyton, 1976; and Kupchella & Levy, 1975). Bluhm (1975) feels that environmental education cannot deal with environmental problems until it deals with ecological principles. In agreement, Hungerford and Peyton (1976) concluded that by itself, "the science of ecology will not solve man's environmental problems even though it can contribute knowledge which may help solve them".

The teaching of ecology as well as environmental education is the responsibility of the public schools (Bluhm, 1975; Bybee, 1979; and Knapp, 1972). But if

teachers are dependent on the ecology chapter of the biology textbook for their environmental education curriculum, a closer look must be taken at how environmental education is presented within the ecology portion of the textbook.

ENVIRONMENTAL EDUCATION IN BIOLOGY TEXTBOOKS

Five widely used biology texts, described in Appendix E, were examined by the researcher to determine the extent to which environmental education was included within each text. The accompanying laboratory manuals for each text were also examined. Of those texts that were examined, the majority devoted considerably fewer pages to the topic of ecology than that given other topics presented within the book. The average amount of space devoted to ecology was approximately 75 pages. This is equivalent to about 10% of the entire book. Although these figures do not appear to be unreasonable, a more careful examination of the content within the ecology unit reveals inadequate treatment of the essential components of environmental education.

The attention devoted to environmental education within the ecology section of each of these texts was assessed by looking at:

1. the amount of page space devoted to ecology/ environmental education
2. the general approach used in consolidating components of environmental education other than ecology into the ecology portion of the text
3. the goal levels met from Hungerford, Peyton and Wilke's "Goals for Curriculum Development in

Environmental Education

4. the general environmental problems/issues that are addressed

A description of the treatment of environmental education in each of the five texts follows:

MODERN BIOLOGY, (1981), by Otto, Towle and Bradley, contains a total of 758 pages. The ecology unit of this text is 5 chapters in length for a total of 75 pages. The last of these chapters occupies 25 pages and is entitled "Human Environmental Problems". This unit contains the only components of environmental education, outside of ecology, found within the book. The general procedure was to define a problem, and discuss why it came about and how it could be prevented. The content of this unit addresses the first two goal levels of Ecological Foundations and Conceptual Awareness. The third level concerning Investigation and Evaluation is partially addressed in the lab activities book wherein two activities involve the investigation of oil pollution and its affect on organisms and succession. Several other environmental problems are mentioned in this last chapter. They include such topics as overpopulation, energy shortages, water and air pollution and soil erosion, among others. The information presented on each of these environmental problems is sometimes as brief as a sentence or two and fails to paint a holistic picture. The focus of the material on these topics is ecologically informative, but lacks a social perspective.

BIOLOGY: LIVING SYSTEMS, (1983), by Oran, Hummer and Smoot, also has 758 pages. Eighty-four pages are devoted to environmental topics, but most of this material concerns ecological concepts. There is very similar treatment given to other goal levels in this text as in MODERN BIOLOGY. The approach used in this book presented the problem, discussed ways it could be prevented or altered and included the most recent discoveries made concerning alternative solutions. The goal levels attained in the text, as in most of the other texts examined, did not exceed level II of the GCDEE (Conceptual Awareness of Issues). A closer look however, revealed that the workbook which accompanies this text contained an activitiy on acid rain investigation, and did well in serving goal level III (Investigation and Evaluation). Air, water, noise and agricultural pollution are the problems mentioned in this chapter as well as radioactive waste, overpopulation and more specific issues concerning acid rain, PCB's and DDT. Again, the lack of time, and therefore space, resulted in the presentation of only a minimal amount of information on these topics.

BIOLOGICAL SCIENCE: A MOLECULAR APPROACH, (1980), (BSCS Blue Version) contains 783 pages. Twenty-five pages are devoted to environmental education--most of which is ecology. A very different approach is used in incorporating elements of environmental education outside of ecology into the ecology section of this text. In the

other texts, a separate chapter is set aside to deal with these other elements. In this text it is woven throughout the sections dealing with basic ecological principles. The term or ecological concept is presented and defined and then such topics as human impact on the environment are discussed in relation to these terms or concepts. For example the concepts of food pyramids and biomass are introduced and their meaning is explained with examples and illustrations. The section that follows this discusses unwanted materials which enter the food pyramid through human activity. Goal levels I (Ecological Foundations and II (Conceptual Awareness of Issues) have been met but not entirely. Again as in the others, too much information is lacking to really develop any kind of awareness of these problems. The environmental problems and issues dealt with are basically the same as those in the texts examined thus far.

BIOLOGICAL SCIENCE: AN ECOLOGICAL APPROACH, (1982), (BSCS Green version) was also examined. This biology textbook has a total of 800 pages. Approximately 140 pages are devoted to ecology and other components of environmental education. It is interesting to note that this text begins with a chapter on ecology. In preparing the student for the remainder of the biology course, it states "you will use over and over again the knowledge you acquire about ecology--about the relationships among organisms and between them and their nonliving

environment". The title indicates the type of approach used throughout the book--one that is ecological. The first chapter introduces the student to basic ecological concepts and terminology which is used throughout the text. Additional components of environmental education are found in small segments throughout the book, but are mainly dealt with in the last chapter on humans and how they fit into the web of life. As is the case in the other biology texts examined, the first and second goal levels can be met by the material contained in the text. However, this text does a more thorough job in presenting the necessary information. Besides presenting the commonly-mentioned environmental problems of pollution, energy shortages, soil erosion and so on, this text also discusses such problems as a solid waste disposal and endangered plant species.

EXPERIENCES IN BIOLOGY, (1981), by Bauer, et. al., is 672 pages in length. The ecology section occupies 54 pages of which 18 pages address the second goal level of environmental education--Conceptual Awareness of Values and Issues. The authors follow the traditional approach of placing the ecology unit at the end of the text and presenting additional principles of environmental education within the last chapter of this segment. However, a unique method was used in presenting this material. The authors chose to introduce human impact and associated environmental problems by giving examples of an individual problem, such as overpopulation, and all the related

problems that can stem from the one. They clearly illustrate the idea that "everything is connected to everything else", a very important concept of environmental education. The authors then tackled each of the environmental problems by presenting the problem and providing basic information as to why it exists. The final section of this chapter discusses the necessity of changing people's values and attitudes as a means towards finding solutions to many environmental problems. This idea was not thoroughly addressed in the other biology texts examined. Several solutions were given for specific problems. Goal levels I and II are addressed by the brief but adequate information given in this text. Level III is partially met by the two investigations offered in the lab book concerning the effects of pollution on the oxygen content of water and the effects of sulfur dioxide on plants. The environmental problems used as examples in most of the other biology texts were also found in this textbook. However, this book was also unique in that it was the only book that looked at any one issue in depth. It posed the question of whether or not utility companies should build more power plants, and went on to present differing viewpoints on this issue.

SUMMARY

It appears as though many biology textbooks have a similar format. The majority of them are characterized by

a similar sequencing of concepts; the placement of ecology at the end of the book; the lack of page space reserved for ecology; and the lack of material devoted to components of environmental education outside of ecology. For the most part, the environmental education material that is presented in these texts did not provide adequate means for achieving the third goal level--Investigation and Evaluation, or the fourth goal level--Environmental Action Skills. Several different environmental problems are looked at, yet the information provided on any one of these is minimal.

It can be concluded that there is a deficiency of environmental education (as earlier defined) within these widely used biology textbooks.

If environmental education can serve as one method for retarding or altering our march toward irreversible environmental degradation, then it is crucial that it be a well-recognized element of the educational process. However, as it stands in biology education, environmental education is not given the appropriate amount of attention. If an adequate program of environmental education were to be infused into the biology curriculum, it would serve to fulfill the demand for social relevance in biology education. At the same time it would develop in students, the necessary skills in investigating, evaluating and decision-making that they will need to make future environmental decisions. It appears as though the

development of an environmental education supplement for biology textbooks is needed and would be a wise investment of time and resources.

CHAPTER III

AN ENVIRONMENTAL EDUCATION SUPPLEMENT

In examining biology textbooks, it appears as though many times the main objective is to convey the factual body of scientific knowledge with little regard to practical application. This seems to hold true for the majority of widely used biology texts. This is not to say that this base of information is unnecessary. If we are to conduct effective discussion on a particular topic or issue, this foundation is a must (Iozzi, 1978). Mertens and Hendrix (1982) emphasized that facts are important but wise decision-making involves a great deal more. The most important skill is learning how to master the facts once they have been learned (Goodrich, 1980). This is a major objective of environmental education. The question can be raised as to whether or not this application of facts, through the teaching of various skills, is a component of present or future goals of biology education.

GOALS OF BIOLOGY EDUCATION

Historical goals of biology education are, for the most part, centered around the same basics as contemporary goals. The difference lies within the manner in which they are updated and prioritized. In order of priority, the following illustrates the present listing of the 5 basic principles upon which the goals of biology education have been, and will continue to be structured (DeHart Hurd, et.

al., 1980):

-Biology education should develop a fundamental understanding of biological systems,

-Biology education should develop a fundamental understanding of, and ability to use, the methods of scientific investigation,

-Biology education should prepare citizens to make responsible decisions regarding science-related social issues,

-Biology education should contribute to an understanding and fulfillment of personal needs and thus contribute to the development of individuals ,

-Biological education should inform students about careers in the biological sciences.

This same study, concerning biology education in secondary schools, also included a table of comparisons between present and prospective goals of biology education (Appendix F), which clearly displays the parallel nature between the goals of environmental education and those of biology. It is reassuring to note that these goals represent the future of biology education. However, the environmental situation is such that it is urgent that education concerning the environment be in progress at the present time. Biology courses at the present must have immediate value in society and be of benefit in the future if we are to achieve scientific literacy, a major goal of biology education (Levin & Lindbeck, 1979), and at the same time environmental literacy, a major goal of environmental education.

Furthermore, in looking at some of the goals of successful science programs, Yager (1982) pointed out that

outstanding features of science programs (related to student behavior) included the following:

- -that students recognize that their lives influence their environment and are influenced by it,
- -that students recognize that some data can be interpreted differently depending on a person's values and experiences,
- -that students possess a sense of custodianship (collective responsibility for the environment over a period of time).

These features are certainly complimentary to the goals of environmental education and vise versa.

Through an understanding of the fundamentals of biology education it has become apparent that many similar goals exist between those of environmental education and those of biology education. In suggesting that an environmental education supplement be designed to accompany biology curriculum, it is necessary to focus on one particular structured program. In this way the supplement could be "customized" to fit the specific content of that particular program. As mentioned earlier, the text is many times considered the curriculum or program of study for use in the biology classroom.

CHOICE OF TEXT FOR AN ENVIRONMENTAL EDUCATION SUPPLEMENT

The MODERN BIOLOGY textbook written by Otto, Towle and Bradley (1981) and published by Holt, Rinehart and Winston, was chosen as the text around which an environmental education supplement should be designed. It carries the

status of being the most widely used biology textbook in the nation. Thus, if a supplement is to be developed, it will have the potential to serve the most individuals.

In looking at the goals of the MODERN BIOLOGY text, DeHart Hurd, et. al. (1980), found that broad goals were not clearly defined in this text. Rather, objectives are stated for the MODERN BIOLOGY program. These objectives mainly deal with the acquisition of biological knowledge. There is some emphasis on personal and social problems, but no consideration given to world or biosocial problems. In the second chapter of this paper, the content of the ecology unit of MODERN BIOLOGY was briefly examined. Again, the ecology section tends to serve as the only location of environmental education in most high school biology textbooks. Stuart (1982) found that MODERN BIOLOGY contains more ecological concepts (32% of the total concepts in the text) than many other high school biology texts. Various environmental problems are also introduced in this particular unit. Although much attention is given this type of information, environmental education remains incomplete until it is brought to stages beyond those concerning ecological knowledge and awareness alone. Higher goal levels of issue investigation, problem-solving and citizen action techniques must be addressed. By itself, the material which is presented in the ecology unit of MODERN BIOLOGY will not suffice in achieving the goals necessary in producing environmentally literate students.

GENERAL OBJECTIVES FOR ENVIRONMENTAL EDUCATION CURRICULA

Childress (1978) in a National Profile of Public School Environmental Education Currricula found that the majority of so-called environmental education programs used objectives which would aid students in becoming more knowledgeable about the enviroment, and which develop an appreciation for natural resources. He pointed out that objectives which focused on developing problem-solving skills were not given as much consideration. Keach (1973) also found that most programs focused on awareness activities. He emphasized that although this was an important step, the need exists for programs to lead from the awareness to the action stage. It is believed that in order for biology to become relevant and significant, students must be afforded the opportunity to examine various environmental/societal issues in detail (DeHart Hurd, 1970).

Schaefer (1979) in examining existing conceptual models of environmental education programs for the schools revealed the following:

-Most existing conceptual models are inconsistent with the infusion approach in that they have little connection with what is being taught within district schools.

-Most existing conceptual models assume that student mastery of the concepts central to the natural sciences guarantees competency in environmental education. Existing frameworks minimize humankind's interaction with the natural environment and downplay the resulting environmental dilemmas.

-Many conceptual models offer simplistic and merely

> descriptive objectives for observing the natural environment and avoid more complex environmental issues and skills.

Curriculum efforts in environmental education should be based on a viable conceptual framework which emphasizes action-oriented activities and the use of inquiry and problem-solving techniques (Troy & Schwaab, 1982). The inclusion of these strategies will serve in achieving future goals of biology education as well as contributing to the effectiveness of a program of environmental education.

INFUSING ENVIRONMENTAL EDUCATION INTO BIOLOGY CURRICULUM

The deficiency of the MODERN BIOLOGY text concerning its treatment of environmental education coupled with the urgency for preparing future citizens to make wise decisions on socio-technical issues related to the environment has been established. What then, may be the best strategy for the design and infusion of a specialized set of curricular materials which would incorporate environmental education into curriculum associated with the MODERN BIOLOGY textbook? Because MODERN BIOLOGY focuses on taxonomic biology throughout the major portion of the book, the first thought that comes to mind might be to environmentalize the entire content of the text. The amount of time, effort and expense involved in environmentalizing MODERN BIOLOGY would be overwhelming.

Nevertheless, in the long run, this appears to be the ideal situation. This approach has been taken by some textbook publishers. Proponents of this approach feel that if we take time out of the regular everyday curriculum to deal with environmental education it will be looked upon as a separate discipline, rather than an underlying concern upon which the curriculum should be built (Schaefer, 1979). Additional support for this method was stated by McInnis in his book YOU ARE AN ENVIRONMENT (1972):

> What we need, before we produce more educational materials, is a new educational strategy. We need to environmentalize education, to make education environmental in essence, rather than merely in in content. Since environment is inclusive of all existing subject matters and disciplines, we need to apply all existing subject matters and disciplines to environmental functions and concerns. And since environments are inclusive of all their members, we need to pursue studies in interaction with our environments rather than in detachment from them. Education will never be truly environmental as long as we continue to prepare young people for participation in the planet's life processes by withdrawing them from those processes for the better part of each day.

An alternative approach might be to rewrite the ecology unit of the text so that it does contain the necessary elements for achieving the goals for environmental education. This would assure that other levels of environmental education would at least be contained within the text which is so often used as the basis for the biology curriculum. It would also be reassuring that environmental education would be given the proper treatment within the text. It must be added though, that this approach is very much in conflict with previous

statements about the importance of infusing environmental education throughout the curriculum. As stated earlier, incorporating higher goal levels of environmental education into only the ecology portion of the text will not solve the problem, nor will it do much to attain the ultimate goal of environmental literacy.

Some people feel that environmental education can be fully served by the development of specialized curricular materials (McInnis, 1972). The researcher feels that for the present, an approach is necessary which would serve to infuse environmental education throughout the curriculum within those classes using the MODERN BIOLOGY text. Such an approach can be successful via an environmental education supplement which accompanies the textbook. This method would not only be more immediate than the process of environmentalizing the text, but would also be more comprehensive than the abbreviated approach of merely including environmental education in the ecology unit of the text.

A supplement is defined as a part added to or issued as a continuation of a book or periodical to correct errors or make additions (Webster, 1977). O'Hearn (1976) concluded that the application and implication of scientific principles and theories in society should be concurrent with the teaching of the basic knowledge of these concepts. He adds that the procedures for doing this would not have to be in the form of a massive overhaul of the curriculum.

He emphasized that need for materials to supplement the existing curriculum which should correspond to the general units found in high school texts. These units would be teacher-based, and include the knowledge, processes and nature of science as well as their social implications. It has been determined that concerning environmental education, activities should be designed in order to correlate with those concepts currently being dealt with in the ongoing academic curriculum (Rillo, 1974).

In connection with this idea, Levin and Lindbeck (1979) stated that in order for biology teachers to deal with problem-solving and the use of controversial issues, they will need to rely on well-prepared supplementary materials which deal with social problems. Wilson and Tomera (1980) proposed that the ultimate goal of environmental education together with the goals of a taxonomic biology program can be achieved via materials which contain the necessary components for developing enviromentally literate students. The data from their research indicated that 10th grade students showed a positive shift towards attaining environmental literacy by being exposed to units of taxonomic biology which incorporated instructional supplements dealing with environmental case studies and simulations. These methods will be more closely examined in the latter portion of this chapter.

It follows then, that supplementary materials if

properly designed, could serve as a valuable addition for concurrent use with the prepared curriculum. At the present time there are two types of supplements available for the MODERN BIOLOGY text. The biology laboratory investigations are contained in a consummable workbook or a nonconsummable lab guide. Each investigation corresponds with a chapter in the textbook. the purpose of this supplement is to engage students in scientific thought and method through an inquiry approach, which allows students to work as "biologists" and discover information in the laboratory. This type of guide allows students to correlate their lab experience with that which they learned from the textbook. Each investigation contains a problem or hypothesis statement; objectives; materials list; an analysis section--which supplies some background research for the investigation; the lab investigation procedures; a data sheet for recording purposes; a summary section; and a listing of additional investigations for students to conduct on their own. The majority of high school biology textbooks offer a similar type of lab supplement. Also available to teachers as a supplement to MODERN BIOLOGY is a choice of 5 regional field guides. These booklets are designed to allow teachers to customize their biology lessons by adding items of local interest such as maps and sketches of the region to include the flora and fauna.

The supplement proposed by the researcher would also be designed to directly complement the sequencing of the

text material. This would enable teachers to present environmental education concepts appropriate to the biology curriculum throughout the course, rather than compressing this material into a single occurrence at the close of the school year. The infusion of environmental education into the curriculum in this manner would allow students immediate insight into the social/environmental relevance of the basic biological principles addressed in their daily instruction.

The rationale for a supplement of this nature has been stated and clarifies the need for an environmental education supplement for the MODERN BIOLOGY curriculum.

The question may arise as to why the researcher is developing a framework rather than the supplement itself. The purpose of this framework is to present a model of the necessary elements the supplement should contain. This includes selected instructional strategies and methods for activities and their justification; a suggested format for the supplement; and appropriate examples of activities it should contain. The actual development of the supplement itself would require an enormous amount of time and expertise. If such a supplement is to be designed for publication, the writers would need to work in conjunction with the regulations and standards posed by the editorial staff of the associated publishing company (Holt, Rinehart & Winston). The intention of the researcher in this paper is to lay the groundwork with the hope that future

development of such a supplement will occur.

CONCEPTUAL FRAMEWORK FOR AN ENVIRONMENTAL EDUCATION SUPPLEMENT

It is important to begin by describing the conceptual foundation upon which the supplement is to be constructed. Many of these concepts have been previously mentioned but will be presented at this point as they apply to the actual design of activities within the supplement. In the transformation of science education, one of the mentioned criteria is that the framework and goals for any undertaking should be the product of appropriate data and conceptual analysis (DeHart Hurd, 1982).

The Intergovernmental Conference on Environmental Education held in 1977 generated the Tbilisi Declaration. This document outlined strategies that should be utilized for creating an awareness and a better understanding of our environmental problems through education. It offered recommendations for the role, objectives and characteristics of environmental education. Also included, were guiding principles that should be followed in environmental education. These principles, listed in Appendix B will be considered in the design of activities within the supplement. Special emphasis will be placed on the last 5 principles which deal with specific methods and opportunities for conveying to students the integral components of environmental education. Many of these

methods will be more closely examined within future portions of this chapter.

The Tbilisi Declaration provided goals and objectives for environmental education, however, these tended to be very generalized and somewhat nondescript. Hungerford, Peyton and Wilke (1977) saw the need for designing specific subgoals from these goals and objectives within the Declaration. These subgoals or goal levels and their components (Appendix A) provide a more explicit set of guidelines, allowing for greater ease in designing curriculum for environmental education. Appendix G displays the comparisons between the Tbilisi objectives and Goals for Curriculum Development in Environmental Education. This illustrates the idea that if curriculum is designed using these goals they will achieve the objectives within the Tbilisi Declaration and fulfill Harvey's Superordinate Goal of Environmental Education-- that of developing environmentally literate citizens.

The activities to be included in the supplement will be designed so that they may serve one or more of the goal levels. An adequate amount of activities will need to be designed for each unit of MODERN BIOLOGY in order to complete the hierarchy of goal levels which is necessary for the development of environmentally literate citizens.

The use of Hungerford, Peyton and Wilke's four goal levels and their components in the design of activities for the proposed supplement will contribute to the effective-

ness of the environmental education instruction. That which is stated within the Tbilisi Declaration along with these four goals will serve as the conceptual framework of goals and concepts for the design of the supplement. (Specific objectives will be stated for each activity within the supplement.)

SELECTED INSTRUCTIONAL STRATEGIES AND METHODS FOR ENVIRONMENTAL EDUCATION

There are a wide variety of instructional methods and strategies recommended for achieving the four goal levels of environmental education. Many of these are aimed at arousing the students interest and emphasize the need for a greater amount of student involvement and participation in the exchange of information throughout the learning process. Many instructional methods have become traditional because of their convenience, both in preparation and time consumption. This has, many times, resulted in a one-way learning environment and tends to bring about monotony and boredom. If we are to develop in the student a desire to act both in public and private sectors for the maintenance of environmental quality, we will have to use effective teaching strategies (Keach, 1973). The use of select methods and strategies for environmental education can enhance the instructional program and aid in its success. McInnis (1972) declared that "what ultimately makes education environmental is not its subject matter, but its

procedures".

In a national profile of environmental education in public schools, Childress (1978) found that of the variety of instructional methods available, the most commonly utilized were such things as small group projects, class discussions, field trips and community resource visits. The activities recommended for the environmental education supplement should include these methods as well as others.

Before examining these methods, it must be established that for an effective program of environmental education, it is necessary that controversial issues be brought into the classroom. Yager, Hofstein and Lunetta (1981) stated that if a science course can connect with current issues and the associated moral and ethical dimensions, it would not only accentuate the importance of studying science, but would also aid in building upon the learner's own experiences. The use of environmental issues within the biology classroom will allow students to participate in the investigational process and allow them to have a stake in determining solutions to the problems and posing future actions (Yager, et. al., 1981). Levin and Lindbeck (1979) revealed that there are few textbooks that give adequate treatment of issues and problems. They felt that biology teachers should make an effort to expand on the use of issues; perhaps by the use of supplementary materials related to societal problems.

In looking at new directions for biology education in

the future, DeHart Hurd, et. al., (1980) saw the need for a flexible curriculum which would not be bound to the textbook, but would allow for current issues and problems. They see, at present and in the future, the focus of decisions concerning the environment as the struggle between a set of values which are reductionistic-mechanical-industrial-technical in nature versus those that are holistic-humanistic-environmental-natural. Bybee (1979) sees the importance in providing science students with the best information on these issues, and familiarizing them with the choices available concerning solutions to these enviromental problems. A "balanced-exposure" approach which allows for a rational and objective examination of all sides of an issue, is seen as a most acceptable approach in dealing with controversial issues in the classroom (Tanner, 1974).

A variety of instructional methods have been selected for specific use in activities to be included in the proposed environmental education supplement.

INQUIRY INSTRUCTION

The term "inquiry" as used in the context of environmental education relates to the development of autonomous learning skills. There are many different modes of inquiry. It is important to point out the distinct roles that teachers and their students hold in the inquiry approach to environmental education.

Traditionally, teachers have played the role of being

a "dispenser of information". Within the inquiry process their role changes to that of a facilitator--one who guides the students along the way. The student's role is to use what abilities they can to arrive at a concept through a deductive approach. It has been argued that deductive reasoning results in higher retention and transfer value of the concepts. Appendix H, from Hungerford's book TEACHING ENVIRONMENTAL EDUCATION (1976), illustrates a dichotomy of teacher-student roles in the inquiry approach to environmental education. Because the learner is involved in the process of discovery, the information is more meaningful, and the learner will be able to apply these skills as new situations arise. The inquiry process therefore leads to the development of students who will be effective problem-solvers.

Methods which employ the inquiry approach provide an opportunity for the learner to discover information and concepts necessary for problem-solving. Strategies which are appropriate to environmental education consist of such things as identifying and classifying environmental issues; comparing information sources on views concerning issues and making inferences and conclusions; using secondary sources in researching environmental issues; analysis of local issues; and obtaining information on issues through primary sources.

A phase of inquiry instruction to be used with environmental investigations is that of a questioning

strategy. This teaching technique will sharpen the learners thinking skills and aid them in interpreting the information they collect. This strategy has been outlined in a packet of teaching materials designed for environmental education by the U.S. Forest Service entitled INVESTIGATING YOUR ENVIRONMENT. It suggests that 4 types of questions be asked in a sequential order. The teacher may use more than one question of each type during instruction. The first type of question is the "open or divergent" question which is geared to elicit a wide variety of responses. These questions may begin with, "What would happen if...?" "How might...?" and so on. The second type of question concerns the process of "recall or memory" and is called the "focus or memory" question. The idea is that the response will be in the form of one specific answer. These questions might begin with, "Who is...?" or "What is...?" The third type of question in this process is called the "convergent" question. The intention is that the response be a result of the learner synthesizing several pieces of information through the recall process. "Why are these things so..." or "How do you explain..." are appropriate starts for convergent or interpretive questions. The final type of question involved in the strategy is known as the "evaluative or capstone" question. It requires the respondent to use his/her values and judgment. It may begin by stating "What can be done about...?" or "What can we say about...?" A well-led

discussion via the use of this type of questioning strategy will aid in encouraging individuals to participate and interact with others and allow for interpreting the information that has been collected from a particular investigation. The instructional use of this type of questioning strategy can significantly contribute to a successful learning experience.

Another phase of the inquiry method and a recommended strategy for use in conducting environmental investigations, is that of a process and problem-solving approach to environmental education. This process is valuable in the collection and interpretation of data for use in posing solutions to particular environmental problems. The 9 sequential steps necessary to complete the process have been identified in Appendix I. Although, for the most part, high school students have mastered most of these individual skills, the important point is that they follow this sequence. These steps, or process skills, can be used with in-class and/or outdoor investigations. The use of this approach can provide the students with problem- solving experiences. Stapp (1978) also outlined a variety of skills for the learner to develop which aid in identifying and solving environmental problems. These skills also follow a logical sequence:

1. Recognize environmental problems
2. Define environmental problems
3. Listen with comprehension
4. Collect information
5. Organize information
6. Analyze information
7. Generate alternative solutions

8. Develop a plan of action
9. Implement a plan of action

Stapp's model, U.S. Forest Service process and problem-solving skills, and selected questioning strategies are phases or approaches to inquiry instruction that may be used for overall instruction in environmental education. These strategies along with the appropriate cognitive knowledge will involve students in developing and carrying out environmental action plans and as a result, produce environmentally literate and active citizens.

VALUES EDUCATION

In order to enhance oneself and improve the quality of life and society, it is essential that future biology curriculum involves questions of not only scientific content, but also those that involve questions of ethics, values and morals (DeHart Hurd, et. al., 1980). The following quote from Bybee (1979) illustrates the importance of including values education as a component of biological education:

> In the crucial period of transformation we can no longer avoid values in science teaching, thus neglecting the human qualities of choice, decision and responsibility. Avoiding controversial issues was satisfactory when the dominant society paradigm needed to be maintained. In a period when new values are emerging we need to look to the future and participate in the construction of a new society.

Mertens and Hendrix (1982) indicated that since the students represent the future decisionmakers, they must understand why they chose particular decisions. This can be done through the clarification of their own values.

Without this insight, many times the decision made is based on a "gut-level" reaction and this approach tends not to consider alternate solutions and their consequences. In other words, the quality of the decision is restricted by gut-level decisionmaking, and this can be broadened by the use of values education. This process will teach students to clarify their values when involved in decisionmaking and in turn, allow them to justify the decision they chose.

Although the area of values has always been a sensitive one in the public schools, if it is dealt with in a select manner, it will decrease the chances of negative repercussions (Howenstine, 1980). It is essential to mention that there are very specific ways to approach values education. Most importantly it must be emphasized that values education does not imply the imposition of the teachers' values concerning a particular issue. The teacher plays a specific role when conducting activities which deal with values processes. The teacher is to present the students with a variety of choices and options to choose from on a particular issue. This should be conducted in a totally nonjudgmental manner. The objective is to help students clarify their own values and allow them to explore optional choices in order to discover the positive or negative consequences these alternate decisions may hold (Mertens & Hendrix, 1982).

Values education involves values analysis and clarification, and moral development (Harshman, 1979). A

closer examination will reveal the importance of using these techniques to achieve many of the goals of environmental and biological education.

Historically, biology teachers have been schooled to convey the facts, theories and concepts of biology in a manner similar to the methods that biologists use in generating new knowledge. However, if we are going to deal effectively with value/moral/ethical issues that have arisen in new biological knowledge, it is necessary that new methods of instruction be implemented.

The process of valuing is the focus of the values clarification approach. Raths, Harmin and Simon (1966), outlined the following objectives for this process, which stated that values clarification should aim towards:

1. encouraging students to make choices and to make them freely
2. helping students to discover and examine available alternatives when faced with choices
3. helping students weigh alternatives thoughtfully, reflecting on the consequences of each alternative
4. encouraging students to consider what it is that they prize and cherish
5. giving students the opportunities to affirm their choices
6. encouraging students to act, behave, and live in accordance with their choices
7. helping students to examine repeated behavior patterns in their lives

The process of values clarification can serve as a valuable tool for the teacher who is concerned with stimulating

thought on the student's personal lifestyles and the impact of these on the environment. The end result of this process is a group of students who are able to clarify their own values concerning the environment and its associated problems.

Values analysis allows students to make and judge decisions concerning a particular issue after having considered the consequences involved. The following steps in the analysis process have been defined as follows (Coombs & Meux, 1971):

1. identifying and clarifying the value question
2. gathering and organizing the facts or statements claimed to be facts
3. assessing the truth of these facts
4. showing that the facts are related to the value question
5. arriving at a possible decision or solution
6. deciding if the possible solution or decision is acceptable to the individual making the decision

Values analysis emphasizes the collection and judgment of facts concerning a particular issue. This six-step process provides students with the means for developing logical arguments and allows them to analyze positions held by others.

Another approach to values education is moral development. It has been found that the decisions and choices which people make have their roots in personal, moral judgments which are reflective of one's values (Iozzi, 1978). Lawrence Kohlberg (1975) developed a model which illustrates the various stages of moral reasoning that take place in an individual's life (Appendix J). As

each stage is reached, one takes on a broader look at that which is concerned. The progression through the various stages is usually considered a long-term process. The attainment of higher stages, to a certain degree, is many times correlated with the maturing process of the individual. When given situations dealing with moral conflicts, wherein the person can exchange his or her views with others and is exposed to higher stages of moral reasoning, moral development can be stimulated (Gray, 1976). If a teacher has some insight as to the moral development stage or stages at which his/her students are operating, they will have the opportunity to present students with moral dilemmas which will require them to operate at a higher level of reasoning than the stage at which the students are currently operating. Students may never progress to a higher stage unless presented with an opportunity to create some type of conflict or moral dilemma, requiring them to understand and perhaps reassess their mode of thinking (reasoning). The higher the stage of reasoning, the greater the concern the individual has towards the welfare of others than his/herself. In its application to environmental problem-solving, it is apparent that the attainment of higher reasoning levels can lead to a reduction of environmental conflicts (Iozzi, 1978).

Moral dilemmas are another type of instructional strategy highly recommended for use with the activities

contained within the environmental education supplement proposed by this paper. The use of moral dilemmas with specific environmental problems or issues may lead to the development of an environmental ethic. For a more vivid understanding of these conflicts and situations, Harshman (1979) suggested that well-led discussions or role-playing be conducted involving these topics. He offers these guidelines in developing moral dilemmas pertaining to environmental situations:

1. Build the dilemma so that it contains a real choice and a variety of plausible alternatives.
2. When possible, use real-life problems. News stories or magazine articles will provide a large variety of situations that are suitable for discussion. Keep a file of articles for use.
3. Keep the story simple, interesting, and short. Unnecessary details should be excluded. In these dilemmas the focus should be on the choice and not on the collection of facts.
4. Construct a focus question that poses a choice.
5. Take care to provide a situation that is a genuine conflict and not a story with a moral. If the "right" answer is obvious, it is not a dilemma.
6. Ask questions about the choice, the reasons for the choice, and alternatives to the choice.

The objective which underlies these processes of values education--values clarification, values analysis, and moral development--is that of creating a disequilibrium in thought which leads to the restructuring of values and reasoning.

In summary, environmental educators can profit via the use of these methods of values education. Values clarification helps students examine the way they look at those things they cherish and relate them to basic elements in the natural and built environment. Values analysis

gives students the opportunity to explore issues in terms of the positions held by those involved in the conflict while allowing the students to reflect and explore the viewpoints they hold concerning each issue. Moral development can aid in the instillment of an environmental ethic which focuses on the concern for the welfare of the group rather than that of the individual alone.

CASE STUDIES AND SIMULATION GAMES

The importance of examining issues, their alternative solutions and their consequences has been emphasized. This can be done via the use of the above strategies. Two successful instructional methods that have been widely used in environmental education are the case study approach and simulation games.

Scientific data used in the context of a case study allows students to see the relationships of this data to their own lives. This information then becomes more meaningful to the student (Mertens & Hendrix, 1982). Exploring issues through the implementation of case studies allows students to examine a real-life situation. With this approach they can study the actual value positions held and the steps involved in the formation of the controversy or issue itself. Case studies allow students to look at alternative solutions to a particular problem, and weigh the advantages/disadvantages of each of these solutions. Through the case study approach the student is able to clarify his/her own value positions pertaining to

the issue and analyze those held by others. Case studies can provide the moral dilemmas for use in values education.

"Knowledge is created out of personal experience, both individual and shared. Students learn from one another and from the synergistic outcomes of the group" (Chapman & Davis, 1973). Environmental simulation games can serve as a valuable instructional tool for providing students with models of real world situations. The students are afforded the opportunity to investigate issues and then interact with others towards the resolution of the involved problems. The issues addressed might encompass local, state or even global proportions.

The implementation of efficient and realistic environmental simulation games, according to Bottinelli (1971), will allow the students to:

-assume roles
-face environmental problems
-formulate strategies
-make decisions
-obtain rapid feedback on the consequences of their decision
-apply previously-learned facts and concepts to problem-solving

Farran (1971) in commenting on the use of simulation gaming with traditional teaching strategies, stated that they can act "as a frame of reference to unite separate ideas students have learned prior to encountering the games....games are unique in providing active arenas for decision-making, rational thinking and planning". Simulation games as a worthwhile classroom technique can best be summarized in a quote from Bottinelli (1971):

> Environmental simulations and games can be of immeasurable value in teaching the multi-faceted and complex issues presented in environmental education units, modules and courses. Although research findings in the cognitive domain are equivocal at this time, the true value of good environmental simulations and games may not be amenable to measurement by paper and pencil tests. Rather, like good art and music, environmental games may instill a deep appreciation of the interrelatedness of all aspects of the ecosphere in the player--deeper than the statistical impression gained by the researcher.

OUT-OF-DOOR LABS

Some of the more popular methods and strategies of instruction associated with environmental education are those which take place outside of the classroom setting. The researcher feels that those experiences to be had outside of the traditional setting are by far the richest and most valuable a student may encounter throughout their formal education. McInnis (1972) most accurately addresses this idea in his response to the question "When is education environmental?"

> Environment begins where you are, not somewhere else. It begins with your communities: the ones that influence you most, and the ones that you influence most...education is most environmental when it increases your understanding of your immediate environments, in the context of broader environmental relationships and concerns.....when it increases your understanding of the nature, culture, technology, people, ideas, and feelings of your environments... when you are learning with your environments as well as about your environments, when you are learning how your environments function as well as about what they consist of.

The out-of-door laboratory is especially useful when teaching ecological concepts, the foundation of environmental education. It is important that teachers

make an effort to use those natural resources that are available--whether it be a barren schoolyard or a heavily wooded area. Field observation has been seen as the essence of ecology (Dexter, 1951). Ecological problems can be studied through observations and can provide data for further exploration in the indoor laboratory. Most importantly, if students are to gain insight into those relationships between elements within the natural environment, recognize their role within the system and be able to make wise choices and decisions concerning their individual behavior, then it is necessary that they become involved in investigating their own immediate environment (Hammerman, 1980).

Students must therefore develop an understanding of the workings of their natural environment before they can understand how and where they fit within our ecosystem. New meaning and appreciation can then be brought to the student through exploring their day-to-day surroundings. Through this investigation the students may then be able to see how familiar areas about them fit into the "total" environment. Without this knowledge, students will view environmental problems and issues as something completely removed from their suroundings. Through these investigations, educators could make environmental education very relevant to the learner (Hammerman, 1951). The use of the out-of-doors is a highly significant and relevant means of addressing the principle concepts of

environmental education. After this comprehension occurs, the actions that the students may take now and in the future concerning environmental problems and issues will have greater meaning.

COMMUNITY RESOURCES

Another instructional strategy for providing students with directly relevant experiences is the use of community resources. It has been suggested by DeHart Hurd et. al. (1980) that the total learning environment of the student be considered in the design of future curriculum in biology. This would include the immediate community and society associated with the learner. Community resources located away from the school site itself might include such facilities as a greenhouse, a canning plant, a sanitary landfill, a fish hatchery, a recycling center, a tree nursery, the local airport or even a local dairy farmer.

There are different approaches for involving students with the local community resources. One way might be to conduct so-called "field trips" to these resources with the intention of familiarizing students with those elements which serve an important function in their day-to-day surroundings. This provides another very relevant firsthand experience for the students and allows them to interact with those people, places and things that makeup their community. These real life situations give the students the insight into how the community functions and needs and problems that might exist within it.

Another way the local community resources might be tapped is through the development of community action projects wherein students actually enter the community to work on local environmental problems. Stapp (1978) in his Instructional Program Approach to Environmental Education--Based on an Action Model--developed specific sensitivity guidelines which should be followed if students are going to conduct community action projects (Appendix K). He comments that thorough preparation is a must for the successful implementation of such projects. With this type of experience the student is given a chance to recognize and become more sensitive towards existing crises and be able to exercise his/her problem-solving skills. these will be of critical importance in their future encounters with environmental problems and issues that may arise.

DISCUSSION GROUPS

Although many of the above strategies and methods of instruction are somewhat more dramatic, there is still need to mention the value of good, sound, in-class, small-group discussion. Glatthorn (no date) feels that the interaction within a small group allows for a very significant kind of learning to occur. This method illustrates another means for students to be actively involved in the learning process. Students do not readily have the opportunity to merely be passive listeners in a small group as easily as they would in a large one. Small-group discussion lends

itself to a more comfortable setting wherein students are less likely to be inhibited about participating. Glatthorn's research has reinforced that students prefer small-group learning. This method allows for a greater degree of teacher-pupil interaction.

In the actual arrangement of small groups, many items need to be considered ranging from the size of the group to the proper physical environment. These small-group sessions provide opportunities for teachers to exercise those skills necessary in utilizing inquiry approaches such as the questioning techniques mentioned earlier. The use of the small-group discussion can convey the same amount of information that might be given through a didactic lecture, but do so in a different and more meaningful manner. The big advantage with small-group discussion is that because the student is very much a participant in the learning process, it strengthens the transfer value of the information/concepts that are of consideration.

This chapter has focused on the examination of the goals and objectives of presently used biology textbooks, and those which makeup the foundation of environmental education. Approaches for infusing environmental education into the biology curriculum have also been discussed and several suggestions have been made concerning instructional strategies and methods which aid in the integration of these two fields of study. In the following chapter the researcher would like to present her ideas for the actual

physical framework for an environmental education supplement for the MODERN BIOLOGY textbook.

CHAPTER IV

SPECIFIC RECOMMENDATIONS FOR THE DEVELOPMENT OF AN ENVIRONMENTAL EDUCATION SUPPLEMENT FOR MODERN BIOLOGY

Throughout this paper an in-depth look has been taken at those elements which comprise environmental education.The intention has been to set the stage for the development of an environmental education activities guide for the MODERN BIOLOGY textbook.

The previous chapter emphasized past and future goals of biology education which indicated the need for the infusion of areas such as environmental education into the curriculum. A few approaches for this infusion were examined with the conclusion that the most efficient and practical method of incorporating environmental education into the biology classroom would be through the implementation of an environmental education handbook/activities book which would supplement the material within the textbook. In this way a teacher would be able to teach those basic principles of biological knowledge and apply this knowledge to those social/ environmental situations that surround the students in their everyday lives.

Chapter III discussed specific recommendations for the design of an environmental education supplemental guidebook. This included the choice of text for which it should be designed and a set of concepts and goals upon which the activities should be based. Suggested

instructional strategies and methods were also discussed which are considered successful techniques for instruction in environmental education.

The purpose of Chapter IV is to synthesize much of what has been examined by presenting a suggested framework for an environmental education supplement for MODERN BIOLOGY and discussing its various components.

There are an unlimited amount of approaches that could be taken to the infusion of environmental education into a biology curriculum, and the same applies to the design of the specialized curriculum materials to be used. A supplement such as that proposed throughout this paper could be designed in a wide variety of ways. It is necessary to emphasize that the following are specific recommendations suggested by the author, based on her research and expertise in the field.

RECOMMENDATIONS CONCERNING THE OVERALL FORMAT AND ACTIVITY DESIGN

In looking at the format for an environmental education supplement for MODERN BIOLOGY, it is important to consider one which would best complement the text material in the most efficient manner possible. One of the strongest considerations to be addressed is the need for a supplement which provides the teacher with a well-organized set of materials that are convenient to use.

Figure 1. displays the suggested format designed by

FIGURE 1. AN ENVIRONMENTAL EDUCATION SUPPLEMENT FOR MODERN BIOLOGY--A SUGGESTED FORMAT

I. INTRODUCTORY ELEMENTS

A. Preface
B. Acknowledgements
C. Introduction to Teachers
D. Instructions for the Use of the Supplement
E. Table of Contents

II. ACTIVITIES

A. Components of each activity:

1. title of activity and title and # of corresponding unit in textbook
2. goal level and conceptual component(s)
3. EE cognitive knowledge concepts
4. topics
5. resources
6. behavioral objectives
7. materials required
8. activity introduction
9. procedure
10. conclusion
11. review questions
12. worksheet original
13. extensional activities
14. optional activities

III. APPENDICES

A. Glossary

B. Curriculum Framework
1. goal levels and conceptual components for curriculum development in EE
2. cognitive knowledge concepts for EE

C. Topic Index
1. environmental topics
2. biological knowledge
3. ecological concepts

D. Resources
1. articles
2. books
3. other publications
4. audio-visual materials

E. Bibliography of Resources
1. articles
2. books
3. other publications
4. audio-visual materials

F. Publishers

G. Guidelines for Requesting Material

H. Addresses for Additional Information and Material

the author. In examining a variety of environmental education materials that currently exist for classroom use, the framework of PROJECT LEARNING TREE (developed by the American Forest Institute in 1977) deemed most suitable as a model for the design of the format for the supplement. This project contains such features as a cross-referencing system and a thorough listing of resources which are appropriate elements for the environmental education supplement.

INTRODUCTORY ELEMENTS

In looking at the suggested format it is evident that the proper introductory remarks be included in the first portion of the book.

The PREFACE should include a description of the philosophy of environmental education and the importance of its inclusion within the biology classroom. It should specifically point out the need for the merging of scientific knowledge and its application concerning social/environmental issues. It should also inform the reader of the type of learning opportunities offered by the supplement.

The ACKNOWLEDGEMENTS should be addressed to those individuals and/or advisory boards or committees who were most fundamental in developing the curriculum, etc. for the supplemental guide.

The INTRODUCTION TO TEACHERS must be a clearly-written, comprehensive statement on how and why the

supplement was developed in the manner chosen--to include comments on the organization of the materials within the guide. This section should serve as an elaboration of the preface wherein many of the concepts and philosophies upon which the guide is based are further explained and justified. A capsulization of the material contained withinChapters I and II of this paper could provide the material for the majority of this introduction to teachers.

INSTRUCTIONS FOR THE USE OF THE SUPPLEMENT should inform teachers as to the best method of implementation of the environmental education activities within the guide to correlate with the curriculum contained within the MODERN BIOLOGY textbook. It is the author's recommendation that each unit of MODERN BIOLOGY be supplemented with a package of environmental education activities. Each package would contain activities which together would serve the 4 goal levels of environmental education and their conceptual components. Each unit and its complementary package of environmental education activities would require 10 periods of classroom instruction. It would be presented in the following manner:

Day 1: Introduction to social/environmental issue (#1)
Days 2-6: MODERN BIOLOGY textbook material
Day 7: EE Activity #2
Day 8: EE Activity #3
Day 9: EE Activity #4
Day 10: EE Activity #5

There may be some disagreement concerning the allottment of 5 days for instruction of the text material for that particular unit. It must be emphasized once again that

this activities supplement will be made available as an option for biology teachers who use MODERN BIOLOGY. If they choose to supplement their text curriculum with these environmental education materials, then it is their responsibility to organize their curriculum in a way to provide students with the basic biological knowledge as well as the skills in how to apply this knowledge to social/environmental problems that they may face in the future. In order for these goals to be met and have successful impact it is necessary that the proper amount of attention be given to these skills and concepts.

The TABLE OF CONTENTS should parallel that which is in the MODERN BIOLOGY textbook. The major divisions of the supplement should correlate with the units in the text. For example, the first unit in MODERN BIOLOGY is entitled "The Nature of Life". The chapter titles are included under this heading. In the supplement, the first heading should also be "Unit 1: The Nature of Life". Instead of the chapter titles, the titles of the appropriate environmental education activities found in the supplement should be listed at this point. In this way a teacher can easily choose from activities that pertain to the material currently being addressed in the text. This system of organization allows for the infusion of environmental education for all 8 units of MODERN BIOLOGY and provides the opportunity for environmental education to be incorporated into the biology classroom throughout the

school year.

ACTIVITIES

There are an infinite number of considerations to be made in the design of activities and their components which are to supplement a text. In this section, some of these items of consideration will be addressed. In addition, the necessary structural components of the activities to be included in the supplement will be examined.

The most important objective to be considered when designing these activities is that the content should provide a relevant extension of that material covered in the text. There must be a logical flow or transition from Day 1, the introduction to the issue, to Days 2-6, the biological knowledge offered in the text which underlies the issue. There must also be a smooth flow from the text material back to the environmental education activities.

The activities should offer a variety of instructional methods and strategies and should focus highly on involving students and encouraging student participation. In addition, these activities should be designed to fit within a time frame of an average class period--approximately 40-45 minutes in length. Both indoor and outdoor settings should be utilized with these activities.

The following section will describe each activity component. Examples of activities will be presented at a further point in this chapter.

Each unit will contain the following components:

1. The title of the activity and the title of the

corresponding unit in the text.

2. The goal level and conceptual components to be served within the activity.(Sample Appendix (SA)IIA)

3. The environmental education cognitive knowledge concepts to be addressed. (SA IIB)

4. The environmental, ecological or biological topics included in the activity. (SA III)

5. Resources such as articles, films, pamphlets, etc...for additionsl use with the activity or for background information for the instructor. (SA IV)

6. Behavioral objectives for the activity.

7. A listing of the materials required for the activity. It is recommended by the author that materials be few in number and/or inexpensive in cost.

8. An introduction to the activity.

9. The general procedures involved in the activity.

10. A conclusion/summary of the activity.

11. Review questions which serve to reinforce the learned concepts and objectives.

12. A worksheet original that teachers may duplicate for student use.

13. Extensional activities that may be used to further enhance the principles and concepts learned and to serve as "extra credit" activities.

14. Optional activities should be available for each activity to provide flexibility for the instructor.

APPENDICES

The MODERN BIOLOGY supplement should contain several different appendices. The author chose to organize these using a cross-referencing system. This provides the teacher with a convenient method of acquiring information related to the environmental education activities within

the guide. This section will describe each appendix.

I. GLOSSARY-As in the biology textbook, the environmental education activities guide should contain a glossary. There will be many terms introduced within these activities that may not be included within the biology textbook.

IIA.,B.-CURRICULUM FRAMEWORK-The inclusion of a listing of the Goals for Curriculum Development in Environmental Education and their conceptual components, (Appendix A),will allow teachers to refer to a full length description of the goals to be fulfilled within a particular activity. This appendix also contains a listing of Cognitive Knowledge Concepts for Environmental Education. These objectives are in the form of conceptual statements with which the student should be familiar at the close of the activity.

III. TOPIC INDEX-This appendix will include 3 sets of topics: environmental issues, ecological concepts and biological principles. Along with each topic listing will be the page and title of those activities which address each topic. In this way a teacher who has a desire to teach about one topic in particular can refer to this list to find the appropriate selection of activities.

IV. RESOURCES-This appendix presents the teacher with a convenient catalog of articles, audiovisual materials, publications and related curriculum materials for use with a particular activity. The activity title is listed and

reference numbers given for each type of resource for that activity. These numbers refer to their appearance within the bibliography.

V. BIBLIOGRAPHY OF RESOURCES-This provides full information on the various resources available as listed in the resources appendix. Each type of resource is listed along with a numbered bibliographic entry. In other words, a teacher may be able to look in the resource appendix (SA IV) for some articles on a particular activity. Those numbers listed next to "articles" refer to the bibliographic entry indicating a location the teacher may contact for more information concerning that resource.

VI. PUBLISHERS-Those publishers which are included within the bibliography are listed along with their addresses in alphabetical order in this appendix. Again, this gives the teacher a quick and convenient reference in the case that material needs to be requested. It serves as a shortcut to searching for these names and addresses within the bibliography.

VII. GUIDELINES FOR REQUESTING MATERIAL-This provides information on the proper actions that should be taken to obtain iformation on any one topic. It is important that these steps be followed to insure a prompt and accurate response.

VIII. ADDRESSES FOR ADDITIONAL INFORMATION AND MATERIAL-This is a helpful list of addresses of companies and organizations that may provide materials or information

on any one topic.

INTRODUCTION TO ACTIVITIES

"Acid Rain" was chosen as the environmental issue around which to design environmental education activities for Unit 5 in MODERN BIOLOGY entitled "Invertebrates". The focus of these activities is the effect that acid precipitation has on aquatic invertebrate organisms.

This topic was selected for a variety of reasons. It is one of the most alarming environmental problems today. Acid rain affects many different elements of our environment and can therefore serve as an interdisciplinary issue in secondary school curriculum. It is a very relevant issue for teaching many biological and ecological concepts. This topic is widely covered in the media and current information is therefore accesible to teachers and students alike.

The acid rain activities are listed in Appendix L. They utilize a wide variety of instructional strategies and methods characteristic of environmental education. In addition, they allow for the accomplishment of the four goal levels of the Goals for Curriculum Development inEnvironmental Education. The incorporation of these activities into the MODERN BIOLOGY curriculum will serve as an extension of the basic biological studies to their application on a social/environmental basis. The sample appendices are given in Appendix M. They were designed to provide the teacher and students with access to those

It is the author's intent that environmental education activities for the other units of MODERN BIOLOGY be developed in the same manner as those in Appendix L. Figure 2. offers a listing of suggested environmental issues for all the units contained within MODERN BIOLOGY.

FIGURE 2. SUGGESTED ENVIRONMENTAL ISSUES FOR MODERN BIOLOGY UNITS

UNIT 1: THE NATURE OF LIFE
- -PCB's
- -Hazardous Wastes

UNIT 2: THE CONTINUITY OF LIFE
- -Overpopulation
- -Radiation Hazards

UNIT 3: MICROBIOLOGY
- -Surfacewater Contamination

UNIT 4: MULTICELLULAR PLANTS
- -Endangered Plant Species
- -Wilderness Preservation
- -Wetland Preservation
- -Food Production Technology
- -Tropical Rainforest Preservation

UNIT 5: INVERTEBRATES
- -Endangered Animal Species
- -Wilderness Preservation
- -Acid Rain
- -Thermal Pollution
- -Pesticide Management
- -Wetland Preservation
- -Habitat Loss

UNIT 6: VERTEBRATES
- -Endangered Animal Species
- -Wilderness Preservation
- -Acid Rain
- -Predator Control
- -Oil Pollution

UNIT 7: HUMAN BIOLOGY
- -Overpopulation
- -Urban Sprawl
- -Noise Pollution
- -Solid Waste Disposal
- -Food Production Technology
- -Food Additives
- -Air Pollution

UNIT 8: ECOLOGICAL RELATIONSHIPS
(Related to all other units)

SUMMARY OF THESIS

The author's intention was to provide the rationale and framework for and environmental education activities supplement for the MODERN BIOLOGY textbook.

In Chapter I, points were addressed which illustrated the crises that presently occur within our environment. It was emphasized that environmental education is a most sound approach to resolving these problems because it has the goal of developing in citizens, the necessary problem-solving and decisionmaking skills they will need to meet with these crises. Chapter I also gave the reader a basic introduction to environmental education concerning what it is, where it is found and how it is treated within these locations.

In Chapter II an in-depth look was taken at the definitions of environmental education and those elements which should comprise this field of study in order to produce environmentally literate students. One of the most important items considered was the Goals for Curriculum Development in Environmental Education (Appendix A), which describes environmental education as a 4-step process. In capsulization this includes:

Level I: Ecological Foundations
Level II: Conceptual Awareness--Issues and Values
Level III: Investigation and Evaluation
Level IV: Environmental Action Skills--
Training and Application

It was also necessary to differentiate between environmental education and other related fields of study i.e., conservation, ecology and outdoor education.

Although environmental education occurs in a variety of situations, the location where it is most commonly found is the secondary school biology classroom. It was determined that biology is the terminal science course for many students and therefore their final and perhaps only encounter with environmental education. This justified the need for it in the schools, particularly within the biology classroom.

It was concluded that the biology curriculum is more times than not, highly equivocal to the material contained within the biology textbook. Therefore, the type of environmental education the students receive is reflective of the quantity and quality of material devoted to environmental education within the textbook.

It was also emphasized in Chapter II, that there is a strong move towards a practical application of the scientific knowledge of biology towards situations that may touch the students in their everyday lives. The statement was made and justified that environmental education could provide the means for casting a socially/environmentally-relevant light onto the arena of factual biological knowledge, so characteristic of most high school biology texts.

The question was raised, "In what way is environmental

education addressed within biology textbooks?" Five widely used biology textbooks were reviewed by the author. It was most commonly found that the first goal level--Ecological Foundations, was the only level sufficiently addressed within these texts. The point was made that environmental education is often viewed as being synonymous with ecology, and the differentiation between the two was again made. Ecology is indeed a very important level of environmental education but it is only the first step and by itself, will not suffice in fulfilling the necessary requirements for satisfying the ultimate goal of environmental education. A note was also made concerning the fact that in 4 out of 5 textbooks examined, the ecology section is located within the last portion of the text. This presents an opportunity for the material to be diminished in length or omitted altogether from the biology curriculum at the end of the academic year.

In Chapter III the present and future goals of biology education were examined. Again, this need for social/environmental relevance was brought out and it was clarified that this need could be satisfied by incorporating environmental education into biology education. An obvious need for environmental education materials designed for biology curriculum--so synonymous with the text content--was indicated. MODERN BIOLOGY, by Otto, Towle and Bradley (1981), was chosen as the textbook for which to design these materials.

A variety of approaches that can be taken to infusing environmental education into the biology curriculum were reviewed. The author examined the possibilities and decided that the most practical and convenient method was that of an environmental education activities supplement which would directly correspond with the material contained within the MODERN BIOLOGY text.

The conceptual framework and basis for such a supplement was illustrated in this chapter. Many well-tested instructional strategies and methods were examined for use in the design of environmental education activities within this handbook.

Chapter IV serves as the culmination and illustration of the many ideas and concepts addressed throughout the paper. Within this chapter, the reader is provided with a of a sample format, activities and appendices, to be included in the supplement. These activities focused on acid rain as the environmental issue and were designed to correspond with Unit 5: Invertebrates in MODERN BIOLOGY.

It was also deemed appropriate to include a list of suggested environmental issues for use with the other units in the MODERN BIOLOGY textbook, in the hopes that further development of this project will occur.

It should be stated that many steps need to be taken between this proposal and the actual development of an environmental education supplement. The author's recommendation is that the next step be in the form of an

needs assessment of teachers who use MODERN BIOLOGY. This will allow for greater accuracy in the design of the supplement. Thought has also been given to the geographic scope to be addressed by the activities in this supplement. It appears that if it were to be designed on a national level, the social/environmental relevance of the issue would need to be diluted, therefore widening the gap between the issue and how it affects students in their own proximal environments. Rather than this approach, the author suggests that supplements be designed for specific regions of the U.S.

The details are many and varied. It is the author's hope that this paper will eventually result in the development of such a supplement, with the ideal outcome of its adoption and publication by the publishers of MODERN BIOLOGY itself--Holt, Rinehart and Winston.

Can it be said that an environmental education activities supplement for MODERN BIOLOGY will suffice in solving these irreversible environmental crises of our times as mentioned in Chapter I? The answer is "no--not directly." But it may be stated that if environmental education supplements are made available for textbooks such as the ever-popular MODERN BIOLOGY, a very important starting point has been established. This type of resource can aid in the development of citizens who are not only aware of the problems, but are also versed in the skills and measures that are needed to alleviate these problems.

These citizens are considered environmentally literate and are able to make intelligent decisions regarding the future welfare of our precious natural environment.

APPENDICES

APPENDIX A

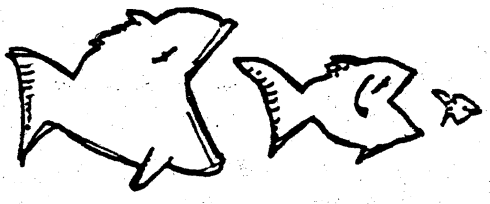
THE GOALS FOR CURRICULUM DEVELOPMENT IN ENVIRONMENTAL EDUCATION

The Superordinate Goal of EE

...TO AID CITIZENS IN BECOMING ENVIRONMENTALLY KNOWLEDGEABLE AND, ABOVE ALL, SKILLED AND DEDICATED CITIZENS WHO ARE WILLING TO WORK, INDIVIDUALLY AND COLLECTIVELY, TOWARD ACHIEVING AND/OR MAINTAINING A DYNAMIC EQUILIBRIUM BETWEEN THE QUALITY OF LIFE AND THE QUALITY OF THE ENVIRONMENT.

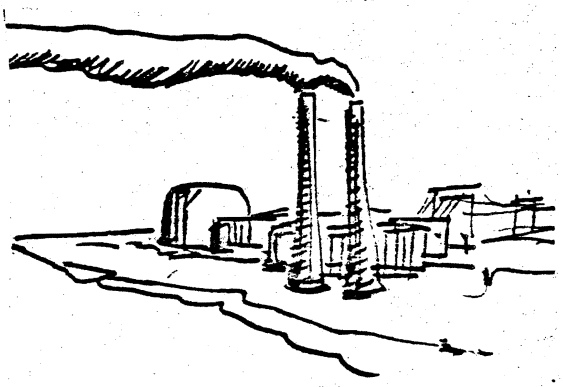
THE GOALS FOR CURRICULUM DEVELOPMENT IN ENVIRONMENTAL EDUCATION

Level I. Ecological Foundations Level:



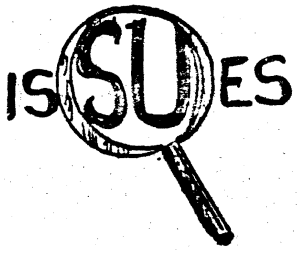
This level seeks to provide the student with sufficient ecological foundations knowledge and how it applies to man-environment interactions to permit him/her to eventually make ecologically sound decisions with respect to environmental issues.

Level II. Conceptual Awareness Level--Issues and Values:



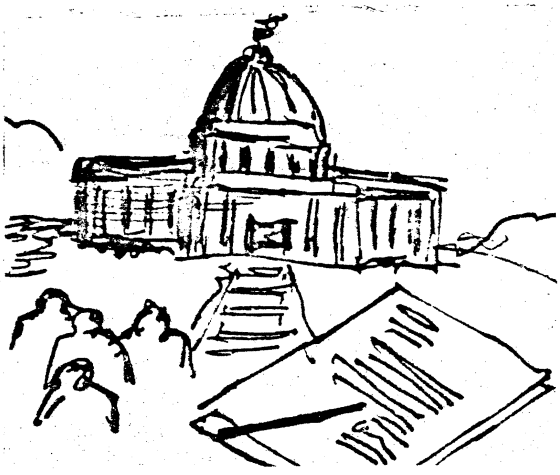
This level seeks to guide the development of a conceptual awareness of how an individual by his/herself or with a group may influence the relationship between quality of life and the quality of the environment, and looks at avenues by which these actions can be solved.

Level III. Investigation and Evaluation Level:



This level provides for the development of the knowledge and skills necessary to permit receivers to investigate environmental issues and evaluate alternative solutions for remediating these issues.

Level IV. Environmental Action Skills Level--Training and Application:



By achieving this level, the student will be provided with the skills necessary to take environmental action. At this level the learner becomas acquainted with various categories of action strategies.

*Goals for Curriculum Development in Environmental Education [1]

The Superordinate Goal: . . . to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment. [2]

Level I. Ecological Foundations Level:

This level seeks to provide the receiver with sufficient ecological foundations knowledge to permit him/her to eventually make ecologically sound decisions with respect to environmental issues.

The Ecological Foundations Level would minimally include the following conceptual components:

A. Individuals and populations.
B. Interactions and interdependence.
C. Environmental influences and limiting factors.
D. Energy flow and materials cycling (biogeochemical cycling).
E. The community and ecosystem concepts.
F. Homeostasis.
G. Succession
H. Man as an ecosystem component.
I. The ecological implications of man's activities and his communities.

(*Hungerford, Peyton & Wilke, 1977.)

Level II. Conceptual Awareness Level - Issues and Values.

This level seeks to guide the development of a conceptual awareness of how individual and collective actions may influence the relationship between quality of life and the quality of the environment . . . also, how these actions result in environmental issues which must be resolved through investigation, evaluation, values clarification, decision making and finally, citizenship action.

Goals at this level are formulated to provide opportunities for receivers to conceptualize . . .

A. . . . how man's cultural activities (e.g., religious, economic, political, social, etc.) influence the environment from an ecological perspective.

B. . . . how individual behaviors impact on the environment from an ecological perspective.

C. . . . a wide variety of environmental issues and the ecological and cultural implications of these issues.

D. . . . the viable alternative solutions available for remediating discrete environmental issues and the ecological and cultural implications of these alternative solutions.

E. . . . the need for environmental issue investigation and evaluation as a prerequisite to sound decision making.

F. . . . the roles played by differing human values in environmental issues and the need for personal values clarification as an integral part of environmental decision making.

G. . . . the need for responsible citizenship action (e.g., persuasion, consumerism, legal action, political action, ecomanagement) in the remediation of environmental issues.

Level III. Investigation and Evaluation Level:

This level provides for the development of the knowledge and skills necessary to permit receivers to investigate environmental issues and evaluate alternative solutions for remediating these issues. Similarly, values are clarified with respect to these issues and alternative solutions. Goals at this level are presented in two components.

Component A: Goals for Component A are to develop in receivers . . .

A. . . . the knowledge and skills needed to identify and investigate issues (using both primary and secondary sources of information) and to synthesize the data gathered.

B. . . . the ability to analyze environmental issues and the associated value perspectives with respect to their ecological and cultural implications.

C. . . . the ability to identify alternative solutions for discrete issues and the value perspectives associated with these solutions.

D. . . . the ability to autonomously evaluate alternative solutions and associated value perspectives for discrete environmental issues with respect to their cultural and ecological implications.

E. . . . the ability to identify and clarify their own value positions related to discrete environmental issues and their associated solutions.

F. . . . the ability to evaluate, clarify, and change their own value positions in light of new information.

Component B: Goals for Component B are to provide receivers with opportunities to . . .

G. . . . participate in environmental issue investigation and evaluation.

H. . . . participate in the valuing process in a manner as to permit the receiver to evaluate the extent to which his/her values are consistent with the superordinate goal of achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

Level IV. Environmental Action Skills Level - Training and Application.

This level seeks to guide the development of those skills necessary for receivers to take positive environmental action for the purpose of achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment. Goals at this level are presented in two components.

Component A: The goal for Component A is to develop in receivers . . .

A. . . . those skills which will permit them to effectively work toward ends which are consistent with their values and take either individual or group action when appropriate, i.e., persuasion, consumerism, political action, legal action, or ecomanagement.

Component B: The goals for Component B are to provide receivers with opportunities to . . .

B. . . . make decisions concerning environmental action strategies to be used with respect to particular environmental issues.

C. . . . apply environmental action skills to specific issues, i.e., to take citizen action on one or more issues.

D. . . . evaluate the actions taken with respect to their influence on achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment.

Implementing the Goals

The utility of the Goals for Curriculum Development in EE lies in their application. Basically, the goals exist as a framework within which specific performance objectives can be written by the curriculum developer from which a curriculum for EE can be developed. As far as the writers can determine, no EE curriculum has ever been developed in precisely this manner. This may expalin why the literature abounds with challenges by professionals, to the community as a whole, to produce syntactically sound curricula which transcend the "awareness level" of receiver achievement.

Although EE curricula abound throughout the world, it is evident that most curricular packages are produced largely on the basis of developer bias and intuition. Many such packages were developed even before any consensus was reached relative to the parameters of EE per se. It would be the writers' recommendation, therefore, that new curriculum development projects are needed and that these projects be responsibly produced with environmental issue investigation and the remediation of issues as major goals. The utilization of the Goals for Curriculum Development in EE would certainly facilitate this process.

APPENDIX B

TWELVE GUIDING PRINCIPLES FOR ENVIRONMENTAL EDUCATION

Twelve Guiding Principles for Environmental Education*

Environmental education should:

1. Consider the environment in its totality--natural and built, technological and social (economic, political, cultural-historical, moral, aesthetic);

2. Be a continuous lifelong process, beginning at the pre-school level and continuing through all formal and non-formal stages;

3. Be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective;

4. Examine major environmental issues from local, national, regional and international points of view so that students receive insights into environmental conditions in other geographical areas;

5. Focus on current and potential environmental situations while taking into account the historical perspective;

6. Promote the value and necessity of local, national and international cooperation in the prevention and solution of environmental problems;

7. Explicitly consider environmental aspects in plans for development and growth;

8. Enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences;

9. Relate environmental sensitivity, knowledge, problem-solving skills and values clarification to every age, but with special emphasis on environmental sensitivity to the learner's own community in early years;

10. Help learners discover the symptoms and real causes of environmental problems;

*UNESCO-UNEP Environmental Education Newsletter, "Connect". Vol. III, No. 1. January, 1978.

11. Emphasize the complexity of environmental problems and thus the need to develop critical thinking and problem-solving skills;

12. Utilize diverse learning environments and a broad array of educational approaches to teaching/learning about and from the environment with due stress on practical activities and first-hand experience.

APPENDIX C

KEY CHARACTERISTICS
OF ENVIRONMENTAL EDUCATION

Key Characteristics of Environmental Education (Hart, 1981)

1. *Interdisciplinary:* Environmental education should be part of every subject taught.
2. *Multilevel:* Environmental education should be taught at all grade levels from kindergarten through grade twelve and beyond.
3. *Global views:* Environmental education involves the development of an integrated global environmental ethic.
4. *Concepts:* Environmental education entails awareness and understanding of basic ecological-environmental concepts (e.g., limiting factors, carrying capacity).
5. *Process development:* Environmental education involves development of cognitive, affective, and skill-behavior processes, especially for development of attitudes and values which motivate people to become involved in environmental problem solving.
6. *Problem solving:* Environmental education involves helping students develop processes of thinking which could be more effective in resolving complex environmental problems.
7. *Values clarifying:* Environmental education involves exploring personal assumptions, values, and feelings toward self and society as well as the relationship of these to the natural world.
8. *Systems thinking:* Environmental education implies that one must learn to think in terms of systems of interacting factors; that is, to think not only rationally about the parts of a complex system but to develop an intuitive feel for the dynamic behavior of such a system as a whole.
9. *First-hand experiences and activities:* Environmental education teaching requires a commitment to the development and utilization of all situations where learning can best be nurtured through first-hand experiences and activities which foster a deep respect and love for the natural world.
10. *Environmental issue oriented:* Environmental education entails use of local environmental issues, as well as case studies, role playing, simulations and games which provide opportunities to examine and participate in the complexities of decision making, understanding of personal and alternative values and the actual operation of systems—natural and man-made.
11. *Present and future orientation:* Environmental education does not exist in the reactive sense only but continually assesses the present and promotes an ideology which examines desirable images of the future.
12. *Active participation:* Environmental education emphasizes active participation in preventing and solving environmental problems.
13. *Individual leaning:* The breadth of environmental education and variety among students implies that individual learning programs involving certain degrees of independent study of a diverse number of interdisciplinary environmental problems will be appropriate.
14. *Team approach to teaching/learning:* Environmental education involves teacher participation in environmental problem-solving learning situations as team members.
15. *New productive student-teacher relationships: Personal responsibility and group interaction:* Environmental education places an emphasis on problem solving which implies many things including recognition of the values and biases of oneself and others and responsibility for working individually and collectively in a process of informed environmental decision making.
16. *Community oriented:* Environmental education involves the entire community as a learning environment in the achievement of environmental education objectives.
17. *Field studies (urban and natural environments):* Environmental education includes provision of field experiences—that group of first-hand experiences which are best suited to areas outside the classroom and school.
18. *Communications networking:* Environmental education entails communication skills as a process which can provide more complete and accurate images about environmental problems. It is important to understand how environmental information flows through networks linking the members of a system together.
19. *Coordination and cooperation: International, national, regional, and local:* Environmental education promotes the value of and necessity for local to international cooperation in the solution of environmental problems.
20. *Flexible administrative organizational patterns:* Institutional flexibility is required to cope with evaluation and provide adequate instruction, given the interdisciplinary problem-solving nature of environmental education.
21. *Reform of educational processes and systems:* Environmental education implies modification of existing educational structures.
22. *Curriculum development base:* Environmental education, because of its program component and support elements and strategies, implies active involvement in the development of new curricula.
23. *Curriculum evaluation base:* Evaluation is required for effective program development in environmental education so as to guide selection of adequate environmental education programs, examine all processes that lead toward achievement of intended outcomes, and judge its appropriateness for support or adoption.
24. *Research base:* Environmental education requires more objective evidence of its benefits and effects in order to buttress rhetoric with instances of success and failure.
25. *Teacher education:* Environmental education involves continued improvement in professional development through inservice and preservice channels to assist in the development of an environmental ethic.

APPENDIX D

STATEMENTS FROM NATIONAL SCIENCE FOUNDATION TEXTBOOK DEPENDENCE SURVEYS

STATEMENTS FROM NATIONAL SCIENCE FOUNDATION
TEXTBOOK DEPENDENCE SURVEYS
(Hurd, Bybee, Kahle and Yager, 1980.)

-The influence of teachers occurs in the choice of a textbook--apparently the most important decision in establishing the curriculum.

-Teachers appear to have "faith" in the textbook; they lament "if only the right one could be found."

-The curriculum, then, is a set of knowledge and skills rooted in the various disciplines and packaged in textbooks.

-Eighty percent of the primary, 90% of the intermediate grade teachers, and 50% of all the teachers base their instruction upon a single textbook.

-The common sequence or pattern for instruction is assign, recite, test, and discuss the test, all based on the textbook.

-Almost all questions arise from information in the textbook and most center on terminology and definition; teachers rely on and believe in the textbooks.

-Most audiovisual materials used tend to supplement textbooks and add to the information base.

-Although the teachers express concern for student attitude, they continue to be imprisoned by the textbook, existing courses, and traditional teaching models.

-Students are trained to seek answers, i.e., the "right" answers from the textbook.

-Textbooks tend to be discipline-bound with little relationship to experiential learning, personal needs of students, and/or societal issues; few examples exist of students learning by experience in schools.

-The reliance of teachers upon textbooks may indicate their inability to conceptualize the dynamic nature of the curriculum, the purposes of education, and the processes associated with student learning.

APPENDIX E

THE SEQUENCING OF MAJOR CONCEPTS IN FIVE WIDELY USED HIGH SCHOOL BIOLOGY TEXTBOOKS

	1	2	3	4	5	6	7	8
Modern Biology 1981 Otto, Towle & Bradley Holt, Rinehart & Winston								
Biology : Living Systems 1983 Oran, Hummer & Smoot Charles E. Merrill								
Biological Science: A Molecular Approach 1980 Blue Version BSCS Staff								
Biological Science: An Ecological Approach 1982 Green Version BSCS Staff								
Experiences In Biology 1981 Bauer, et. al. Laidlaw Bros.								

Cell Structure and Function

Simple Life Forms

Genetics and Evolution

Plants

Animals

Human Structure and Function

ECOLOGY

APPENDIX F

A COMPARISON BETWEEN
PRESENT AND PROSPECTIVE GOALS OF BIOLOGY EDUCATION

A COMPARISON BETWEEN

PRESENT AND PROSPECTIVE GOALS OF BIOLOGY EDUCATION*

PRESENT	PROSPECTIVE
-Biology as a discipline is the organizational structure for knowledge.	-Human adaptation in bio-social context will be the organizational structure for knowledge.
-Social problems have marginal emphasis in biology programs.	-Social problems and issues will be central to biology programs.
-Inquiry skills characteristic of a generalized model of science is both a goal and a method of teaching.	-Inquiry processes unique to biological disciplines will be added to traditional goals.
-Discovering a correct answer for a discipline-bound problem is a goal of laboratory program.	-Decision-making involving biological knowledge in bio-social contexts will be an important goal of the biology program.
-Minimal attention to careers, mostly of historical importance and biased toward an elite view of science.	-Career awareness, an integral part of learning, and a variety of science related career opportunities for all individuals will be stressed.
-Value-free interpretations of discipline-bound problems is the present orientation of biology programs.	-Value, ethical, and moral considerations of bio-social problems and issues will be a goal of biology programs.

* DeHart Hurd, Paul, R.W. Bybee, J.B. Kahle and R.E. Yager. Biology education in the secondary schools of the United States. American Biology Teacher. 42(7), pp. 388-404. 1980.

APPENDIX G

A COMPARISON OF THE GOALS FOR CURRICULUM DEVELOPMENT IN ENVIRONMENTAL EDUCATION TO THE TBILISI CONFERENCE CATEGORIES OF OBJECTIVES

Tbilisi Objectives					Developers' EE Curriculum Goals by Level
Awareness	Knowledge	Attitudes	Skills	Participation	
1	2	3	4	5	
					Level I. Ecological Foundations Level
X	X				All Subcomponents (A-I)
					Level II. Conceptual Awareness Level
1	2	3	4	5	Subcomponent:
X	X				A
X	X				B
X	X				C
X	X				D
X	X	X			E
X	X	X			F
X	X	X			G
					Level III. Investigation and Evaluation Level
1	2	3	4	5	Subcomponent:
X	X		X		A
X	X		X		B
X	X		X		C
X	X		X		D
X		X	X		E
X	X	X	X		F
X	X	X	X	X	G
X		X			H
					Level IV. Action Skills Level
1	2	3	4	5	Subcomponent:
			X		A
			X	X	B
				X	C
				X	D

Fig 1: Developers' Validity Assessment - A Comparison of the Goals for Curriculum Development in Environmental Education to the Tbilisi Conference Categories of Objectives (1977).

APPENDIX H

STUDENT/INSTRUCTOR ROLES IN ENVIRONMENTAL EDUCATION INQUIRY

STUDENT/INSTRUCTOR ROLES IN ENVIRONMENTAL EDUCATION INQUIRY*

THE INSTRUCTOR'S ROLE

1. Evaluates students' abilities to use inquiry skills prior to their conducting autonomous research.. Further, if these skills are lacking the instructor will implement instructional strategies to insure the acquisition of inquiry skills.

2. Provides an environment (educational climate) within which inquiry can take place.

3. When necessary, provides students with alternatives from which the student may choose for inquiry.

4. Acts as a consultant to students when they are in need of assistance either in the form of usable information or suggestions for inquiry strategies which could be used.

5. Motivates students to work toward closure on their inquiry via praise and positive criticism.

6. Helps the student evaluate the final products of inquiry as well as value perspectives which have come about as a function of new knowledge.

THE STUDENT'S ROLE

1. Uses the ability to identify an environmental issue.

2. Uses the ability to identify differing value positions which clash on an issue.

3. Uses the ability to distinguish between problems which can be investigated using primary and secondary sources of information. (or both).

4. Uses the ability to search out pertinent information on environmental issues using secondary sources of information by...
   - A. using the Reader's Guide.
   - B. using the Card Catalog.
   - C. comparing two or more information sources for varying value positions.
   - D. summarizing information gathered via secondary sources
   - E. writing letters which prove effective in obtaining secondary source data.

5. Uses the ability to collect pertinent information on environmental issues using primary sources of information by...
   - A. observing critically.
   - B. using interview techniques.
   - C. using surveys.
   - D. using questionnaires.
   - E. using opinionnaires.
   - F. using experimental techniques.

Hungerford, H.R. and R. Ben Peyton. Teaching Environmental Education. p. 13, 1976.

APPENDIX I

PROBLEM-SOLVING PROCESSES FOR ENVIRONMENTAL EDUCATION

PROBLEM-SOLVING PROCESSES*

PROCESS
OBSERVING: Learner uses several of the senses (tasting, feeling, seeing, hearing, smelling, etc.) to collect data about environment.
MEASURING: Using standard units of measure and "invented" units to determine quantity, quality, and extent.
CLASSIFYING: After determining similarities and differences, learner places objects, ideas into groups or categories.
INFERRING: On the basis of collected data and observations, learner can determine some possible reasons for observation.
PREDICTING: On the basis of current data and experience, learner foretells future events, conditions, etc.
COMMUNICATING: Learner can present information and ideas to others in verbal and nonverbal forms.
FORMULATING HYPOTHESES: On the basis of preliminary experience and inferences, the learner establishes the direction for further inquiries.
EXPERIMENTING: Learner seeks to find answers to an unsolved problem through various methods of testing, data collection, and interpretation.
INTERPRETING DATA: Collected data are organized and compared with previously varified data in order to determine meaning.

*Investigating Your Environment Series. Forest Service, United States Department of Agriculture, 1980.

APPENDIX J

KOHLBERG'S MORAL REASONING STAGES

KOHLBERG'S MORAL REASONING STAGES

I. Preconventional Level

At this level, the child is responsive to cultural rules and labels of good and bad, right or wrong, but interprets these labels either in terms of the physical or the hedonistic consequences of action (punishment, reward, exchange of favors) or in terms of the physical power of those who enunciate the rules and labels. The level is divided into the following two stages:

Stage 1: The punishment-and-obedience orientation. The physical consequences of action determine its goodness or badness, regardless of the human meaning or value of these consequences. Avoidance of punishment and unquestioning deference to power are valued in their own right, not in terms of respect for an underlying moral order supported by punishment and authority (the latter being Stage 4).

Stage 2: The instrumental-relativist orientation. Right action consists of that which instrumentally satisfies one's own needs and occasionally the needs of others. Human relations are viewed in terms like those of the marketplace. Elements of fairness, of reciprocity, and of equal sharing are present, but they are always interpreted in a physical, pragmatic way. Reciprocity is a matter of "you scratch my back and I'll scratch yours," not of loyalty, gratitude, or justice.

II. Conventional Level

At this level, maintaining the expectations of the individual's family, group, or nation is perceived as valuable in its own right, regardless of immediate and obvious consequences. The attitude is not only one of conformity to personal expectations and social order, but of loyalty to it, of actively maintaining, supporting, and justifying the order, and of identifying with the persons or group involved in it. At this level, there are the following two stages:

Stage 3: The interpersonal concordance or "good boy - nice girl" orientation. Good behavior is that which pleases or helps others and is approved by them. There is much conformity to stereotyped images of what is majority or "natural" behavior. Behavior is frequently judged by intention - "he means well" becomes important for the first time. One earns approval by being "nice".

Stage 4: The "law and order" orientation. There is orientation toward authority, fixed rules, and the maintenance of the social order. Right behavior consists of doing one's duty, showing respect for authority, and maintaining the given social order for its own sake.

III. Postconventional, Autonomous, or Principled Level

At this level, there is a clear effort to define moral values and principles that have validity and application apart from the authority of the groups or persons holding these principles and apart from the individual's own identification with these groups.

Stage 5A: The social-contract orientation, generally with legalistic and utilitarian overtones. Right action tends to be defined in terms of general rights and in terms of standards which have been critically examined and agreed upon by the whole society. There is a clear awareness of the relativism of personal values and opinions and a corresponding emphasis upon procedural rules for reaching consensus. Aside from what is constitutionally and democratically agreed upon, the right is a matter of personal "values" and "opinion". The result is an emphasis upon the "legal point of view", but with an emphasis upon the possibility of changing law interms of rational considerations of social utility (rather than freezing it in terms of Stage 4 "law and order"). Outside the legal realm, free agreement and contract is the binding element of obligation. This is the "official" morality of the American government, and finds its ground in the thought of the writers of the Constitution.

Stage 5B: Higher law and conscience orientation. Orientation to internal decisions of conscience but without clear rational or universal principles. Conform to avoid self-condemnation.

Stage 6: The universal-ethical-principle orientation. Right is defined by the decision of conscience in accord with self-chosen ethical principles appealing to logical comprehensiveness, universality, and consistency. These principles are abstract and ethical (the Golden Rule, the categorical imperative); they are not concrete moral rules like the Ten Commandments. At heart, these are universal principles of justice, of the reciprocity and equality of human rights, and of respect for the dignity of human beings as individual persons.

APPENDIX K

SENSITIVITY GUIDELINES FOR STUDENTS ENTERING A COMMUNITY TO WORK ON LOCAL ENVIRONMENTAL PROBLEMS

SENSITIVITY GUIDELINES FOR STUDENTS ENTERING A COMMUNITY TO WORK ON LOCAL ENVIRONMENTAL PROBLEMS*

Students entering a community to work toward the solution of local environmental problems should receive intrapersonal and interpersonal training. It is also important that consideration be given to the process of identifying, selecting, implementing, and evaluating community action projects. It is also important to prepare the community for students entering it to study particular problems. The following guidelines have been developed for these purposes to aid students involved in community action projects:

1. Self and resource evaluation.

    a. Be aware of their personal values (e.g., elitism-classism, racism, sexism, ageism, etc.) and arrange for training sessions to work on conflicts.

    b. Be aware of personal values that might be different from the values of the community sector that you will be working with. Arrange for training sessions to work on value conflicts and to foster value sensitivity.

    c. Be aware of interpersonal relationships and arrange for training sessions to work on problem areas (personality barriers, working relationships, etc.)

    d. Be aware of the resources that you and each of the other members bring to the team.

*Stapp, William B. An Instructional Program Approach To Environmental Education (K-12) Based on an Action Model. University of Michigan School of Natural Resources. September, 1978.

2. Sensitivity toward the community.

   a. Do not enter the community like gangbusters.

   b. Be a good community listener.

   c. Do not seek to replace existing community leaders. They will be there long after you leave.

   d. Be informed about the community (the people, the government, politics, functioning of community, living conditions, environmental status, concerns of the residents, etc.).

   e. Be aware of and work with community people and organizations that have the resources and past experience to assist you in your community problem-solving project.

3. Identification of community projects.

   a. Obtain ideas from students, faculty, school administration, citizens, government officials.

   b. Attend public hearings and meetings.

   c. Read community newspapers and newsletters.

   d. Listen to local public-affairs radio and TV programs.

4. Selection of community action projects.

   a. Review all community projects identified through process 3 (above).

   b. Make your project selection after considering items such as student interest in project, student and community priorities, available resources, funding, risks involved (personal, class, school, etc.), school board policy, and the social implications of the work you are planning in the community.

5. Implementing community action projects

   a. Involve the learner; do not be leader-centered.

   b. Be a facilitator, not a commentator.

   c. Give credit where credit is due; practice humility.

   d. Be aware of the social implications of your actions.

   e. Develop strong ties with community individuals and organizations in order to build your power base and to provide on-going support for the project.

APPENDIX L
SAMPLE ACTIVITIES
FOR AN ENVIRONMENTAL EDUCATION SUPPLEMENT
FOR MODERN BIOLOGY

TITLE: Unit 5: Invertebrates
Day 1: Values Continuum* and Discussion--
Environmental Effects and
Invertebrates

GOAL LEVEL/ COMPONENTS: Level I
A,B,C,H,I

COGNITIVE KNOWLEDGE CONCEPTS:
#2,5,7,28-30,45-50,53,65,83-85,89,96,98-100

TOPICS: Environmental: Acid Rain
Biological: Invertebrates
Ecological: Limiting Factors; Interdependence

RESOURCES: Articles: #2,19
Books: #3,4
Other Pub: #1,2,3,6
AV: #2,3,5,7

OBJECTIVES: The students will be able to:
-Define their value positions concerning humans and their role in environmental problems
-Verbally state the definition of invertebrates and limiting factors and cite examples of each
-List environmental problems which could affect invertebrates
-State the importance in gaining an understanding of invertebrate biology

MATERIALS: -invertebrate specimens

INTRODUCTION:

Tell the students that "We are all a vital part of the ecosystem and our individual and/or group actions can play a vital role in its survival. If we are to be influential in solving a particular environmental problem or issue we must sort out our feelings and gain a better understanding of how and why we feel the way we do. We must also gain the basic knowledge about those factors involved, both living and nonliving, in order to have a full understanding of the basis of these problems."

PROCEDURES:

A. Arrange 5 chairs or desks in a row, leaving several feet in between each so as to form 4 separate areas along a line.

B. Explain to the class that you are going to read several value-related statements for which they are to respond by walking to the area which represents their position on the statements.

1. The spaces should symbolize, left to right, strongly agree, agree, disagree, strongly disagree.

2. Of course, any student may pass, and not respond.

C. After each question, have a few students share their reasons for their particular positions.

D. Continue this same procedure for other statements.

E. Let the class or yourself suggest other value statements.

Sample Valueing Questions:

A. More emphasis should be given to problems of environmental nature which are caused by the individual citizen instead of problems which are caused by industrialists.

B. The concept of cycles is encountered frequently in ecology. Yet, modern society is ignoring this basic law in its uses of natural resources.

C. It is primarily the responsibility of the government to control air pollution.

D. The environmental crisis cannot be solved in the context of our present political and economic system.

E. Any pollution act of a person is an infringement on the rights of another and should be so regarded in the courts.

F. Local organization is the key to effective environmental action; that is, battles on big national issues are ultimately based on grassroots supports.

G. As long as we have to go through democratic processes to make changes, there is no chance of our moving fast enough to save the environment.

H. There should be commuter taxes levied of persons who live in the suburbs and work in the central city, and the money used for the construction and imporvemet of public transit.

I. Modern technology will enable man to continue to enjoy the present standards of living for many decades to come.

J. The younger generation in America really does not want to change the basic way of life in this country.

Debriefing:

A. If students tend to cluster together because of peer pressure, you can have the students answer the statements on paper.

B. A wide spread of positions usually indicates a good continuum statement, which causes critical thinking.

C. This activity is good for introducing a particular unit by making statements pertaining to that unit.

Now reassemble students for discussion. Ask them, "What kind of pollution affects the plants and animals in our environment and why?" Briefly explain that acid rain is the largest environmental problem concerning invertebrates and we will be examining this danger and how it affects plants and animals. Discuss the fact that within the unit in the text they will be studying over the next few days, they will be introduced to the world of

invertebrates. Ask them to define the word invertebrates and give examples. List these on the board and allow students to examine specimens. State that each of these organisms, as do humans, live within the boundaries of certain limiting factors. Define the term limiting factor and list those on the board which exist for humans versus invertebrate organisms. Consider the lowly sea cucumber have the students state particular limiting factors that the sea cucumber may have to live with. Ask the students the following questions: Does the sea cucumber share similar limiting factors with other invertebrates? with humans? How could acid rain affect the sea cucumber's lifestyle? How about other invertebrates? vertebrates (to include humans)?

CONCLUSION:

Tell the students,"In order to fully understand the implications that acid rain can have on various invertebrate organisms, we must further examine theindividual characteristics and environments in which these organisms survive. Only then can we review our role as humans as a part of the ecosystem and look at ways in which environmental problems, such as acid rain, may be resolved.

REVIEW QUESTIONS:

1. What are invertebrates? Give examples.
2. What is the most looming enviromental problem concerning invertebrate organisms?
3. What are limiting factors? Give examples.
4. Why is it important to be familiar with the physical characteristics and functions of invertebrate organisms?

EXTENSIONAL ACTIVITIES:

Have students clip and summarize newspaper articles which concern acid rain and its affect on aquatic organisms.

OPTIONAL ACTIVITIES:

A. Brainstorm environmental issues which may affect plants and animals. List on board. Discuss the ways in which they affect these plants and animals. Ask the students to select the most important issue and have them give their reasons. Discuss the ways in which acid rain can destroy the delicate ecosystems of aquatic invertebrates.

B. Have the students list all of the "critters" that they know of which live in a local pond, lake or stream. Ask them if they feel if any of these organisms are in danger, and if so, why? Discuss the affects that acid rain could potentially have on this particular body of water.

*(Adopted from ENVIRONMENTAL EDUCATION ACTIVITIES MANUAL. William B. Stapp and Dorothy A. Cox, pp. 536-537. 1979.)

TITLE: Unit 5: Invertebrates
Days 2-6

PROCEDURES:

During these 5 days the teacher will have an opportunity to convey the textbook knowledge in Unit 5: Invertebrates, in any manner he/she chooses. These environmental education activities are to straddle the material contained within each unit of the text. It is the responsibility of the teacher during days 2-6 to relate the material contained within the associated environmental education activities to that which is in the text.

TITLE: Unit 5: Invertebrates
Day 7: Acid Rain: Its Causes and Effects

GOAL LEVEL/ COMPONENTS	Level I	Level II
	I,D,H,I	A

COGNITIVE KNOWLEDGE CONCEPTS:
2,7,10,45,50,64-66

TOPICS:
- Environmental: Acid Rain
- Biological: Invertebrates
- Ecological: Biotic/Abiotic Factors, Interdependence, Limiting Factors

RESOURCES:
- Articles: #3,4,6,7,8,13,15,19
- Books: #1,2
- Other Pub: #5
- AV: #1,4

OBJECTIVES: The students will be able to:
- Define acid rain
- Identify and explain 2 major causes of acid rain
- List 4 effects acid rain has on the environment
- Identify those individuals/groups most responsible for the continuing acid rain problem

MATERIALS:
- a slide of a lake in Ontario or the Adirondacks
- coal
- Bunsen burner
- transparencies of the sulfur cycle, nitrogen cycle, and one listing the effects of acid rain
- overhead projector
- exhaust pipe
- sample of H_2SO_4
- limestone

INTRODUCTION:

Tell the students, "Acid rain is one of the major environmental issues of the 1980's. The term implies something that is unnatural and dangerous and implies destruction and damage. Let's take a closer look at the formation and effects of acid rain."

PROCEDURES:

Begin by showing the class a slide of a beautiful lake in Ontario or in the Adirondacks. Use the following lecture/discussion narrative:

"Pretty little lake isn't it? So crystal clear and all. Too bad this lake is dead. And the worst part is that you and I may be partially responsible for killing it.

Can any of you tell me what may have caused this lake to die? The problem is called "acid rain" and it has very damaging effects. Acid rain is precipitation in the form of rain, snow, hail, sleet or fog, which is very acidic."

(Demonstration--burn a piece of coal over a Bunsen burner.)

"Can everyone smell that? What exactly is that smell? What is coal made of and how is it formed? How is coal related to acid rain?"

(Project transparency of the sulfur cycle and trace its flow.)

"Can anyone think of anything else that is put into the atmosphere that also contributes to acid rain?"

(Throw an exhaust pipe on the front lab table.)

"Does this give you a hint?"

(Project transparency of the nitrogen cycle and trace its flow.)

"Acid rain does more damage than just killing lakes. Have you heard of any other effects it may have on the environment?"

(Project transparency listing the effects of acid rain and discuss.)

"There are many delicate statues and buildings that are being "eaten away". Can you think of how acid rain can cause this? What happens when sulfur dioxide mixes with water in the air?"

(Draw the following equation on the board: $SO_2 + H_2O = H_2SO_4$ (sulfuric acid).)

"Let's see a small scale model of what happens when the two mix."

(Demonstration--let a student put a few drops of H_2SO_4 on a piece of limestone and have the rest of the class observe.)

"The acid actually dissolves the limestone, of which many statues and buildings are made. This is a very real look at the kind of damage that acid rain can cause over a rather short period of time."

CONCLUSION:

Ask the students the following questions: Who or what can be considered the most responsible for acid rain damage? How might the increased acidity of water bodies, an abiotic factor, affect those organisms, biotic factors, that live within? Could the acidity of the water be considered a limiting factor for invertebrates?

REVIEW QUESTIONS:

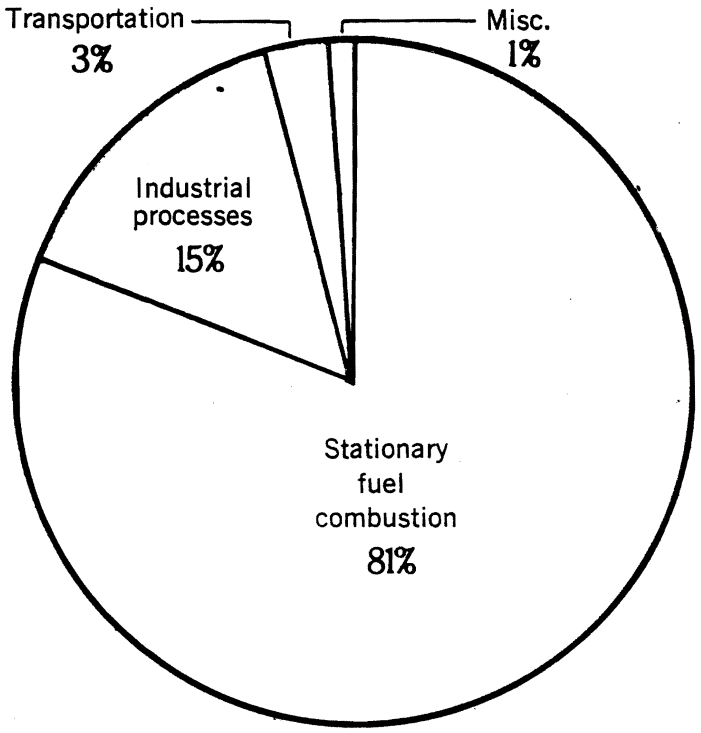
1. How does a dead lake (from acid rain damage) appear?
2. What is acid rain and how does it form?
3. What kinds of things are affected by acid precipitation?
4. Who or what is responsible for acid rain?

EXTENSIONAL ACTIVITIES:

Have students research the impact that acid rain is having on the water systems within the state.
Have the students choose one invertebrate organism and report on its physical characteristics, its habitat features, its food sources and the type of animals which use it as a food source. Have the students explain the ways in which acid rain could affect this organism.

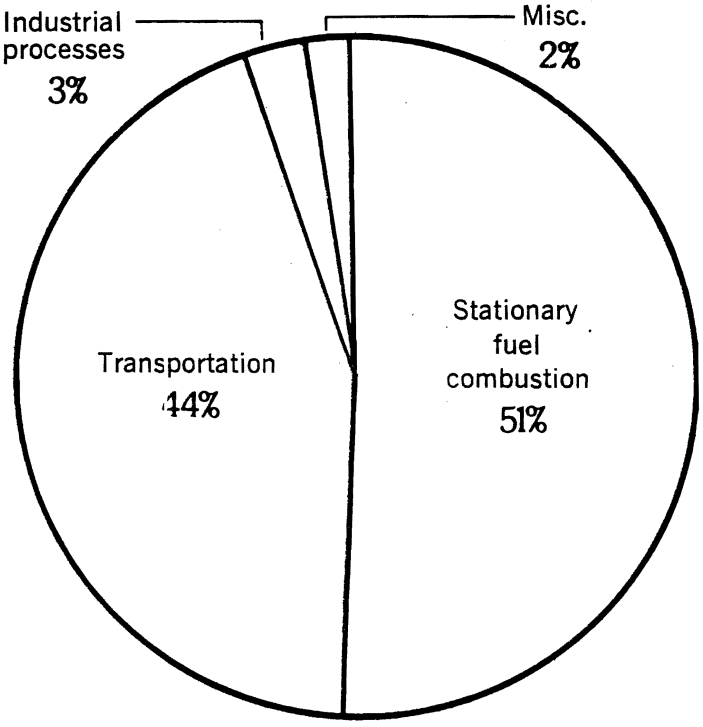
OPTIONAL ACTIVITIES:
Observe the slide/tape program: "Acid Rain: The Choice is Ours" and discuss why it is important to control acid rain, and ways in which acid lakes and streams can be helped.

Sulfur and Nitrogen Oxide Emissions – 1976



Sulfur Oxides

Total — 26.9 million metric tons



Nitrogen Oxides

Total — 23 million metric tons

Source: EPA — 450/1-78-003

Transportation = highway and nonhighway vehicles

Stationary Fuel Combustion = chemicals, petroleum refining, metals, mineral products, oil and gas production and marketing, and industrial organic solvent use

Miscellaneous = forest wildfires and managed burning, agricultural burning, cool refuse burning, structural fires, misc. organic solvent use, solid waste

TITLE: Unit 5: Invertebrates
Day 8: Am(pH)ipods: An Acid Test*

GOAL LEVEL/ COMPONENTS:	Level I	Level II	Level III
	C,I	A,B	A

COGNITIVE KNOWLEDGE CONCEPTS:
7,10,45,47-49,54,64-66,83,84

TOPICS: Enviromental: Acid Rain
Biological: Invertebrates
Ecological: Habitat; Ecosystem; Limiting Factors

RESOURCES: Articles: #11,13,16,17,20,22,24,26
Books: #6,7,8
AV: #8

OBJECTIVES: The student will be able to:
-Define pH
-Measure the pH of various solutions
-Identify the effects of pH changes on GAMMARUS
-List 4 factors upon which aquatic organisms depend

MATERIALS:
-GAMMARUS
-glass Containers-100 and 500ml beakers, baby food jars, canning jars, small aquaria
-spring water-500ml for each jar
-pH paper
-labels/masking tape
-culture dishes
-pipettes-bulbs 2.5cm diameter, glass tubing with an internal diameter of 3mm
-10% H_2SO_4
-dropper bottles
-stirring rods

INTRODUCTION:

GAMMARUS are micro-crustaceans found in ponds and streams. They are known as amphipods or "scud". GAMMARUS are very active acrobats: they swim, they jump, they crawl...they are almost always on the move. Once you know what (and where) to look for (in decaying vegetation, under stones and rocks) they are easy to collect. They are also easy to raise and maintain in the lab. In the event that you have not had experience with GAMMARUS, some readily accessible references which describe what "scud" look like and their care and feeding, will be made available to you. These freshwater invertebrates are easy to collect and not too expensive to purchase.

PROCEDURES:

You can prepare the solutions before class or better,

prepare the solutions as a class demonstration. If GAMMARUS are obtained from a biological supply house, use bottled spring water with a pH of approximately 6. If you and/or your students collect the organisms, use water from the pond or stream. Spring water is very close to pH 6. The number of drops suggested in the chart below are estimates. As drops are added, be sure that you stir the solutions thoroughly. The pH must be stabilized before you use them. Students could help you take the pH measurements. The H_2SO_4 recipe is:

a. 500ml of spring water (ph6)
b. 500ml of spring water + 5 drops of 10% H_2SO_4 (pH5)
c. 500ml of spring water + 15 drops of 10% H_2SO_4 (pH4)
d. 500ml of spring water + 25 drops of 10% H_2SO_4 (pH3)
e. 500ml of spring water + 30 drops of 10% H_2So_4 (pH2)
f. 500ml of spring water + 35 drops of 10% H_2So_4 (pH1)

The student assignment sheets (attached) are divided into two activities. In activity 1, students become familiar with the morphology, physiology and behavior of GAMMARUS. In activity 2, students determine the effects of acid rain on GAMMARUS behavior and survival. Activity 2 cannot be completed in one class period. Amphipods may live for several hours at pH 2. You should make provisions for some students to return to make observations later in the school day and after school or have subsequent classes continue the observations. If experimental organisms are alive in pH containers below the level of 5.6 after 24 or 48 hours, you may elect to set up a longer term experiment.

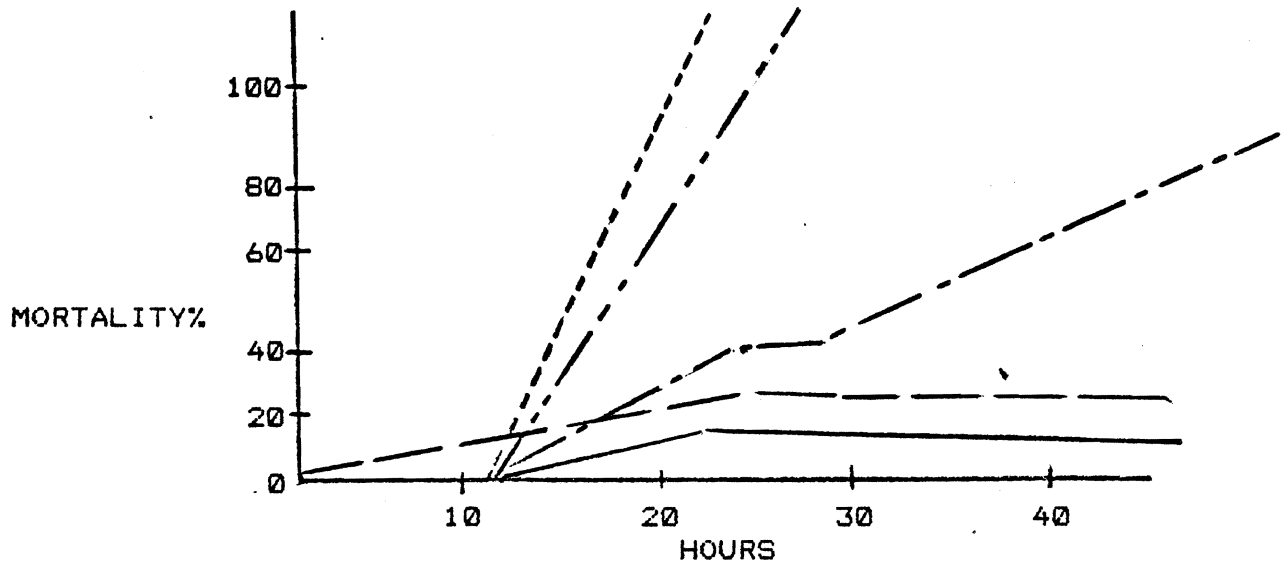
CONCLUSION:

When students are finished, have them answer the following questions:

a. What is the purpose of the pH container?
b. What do your findings tell you about the relationships between pH, time and mortality?
c. What would you need to know to make a more educated hypothesis about what would happen to a food web in a pond or stream if GAMMARUS became extinct? How would you find out?
d. Why are most ponds, lakes and streams not at a pH of 7, which is neutral?
e. If an early spring thaw produces meltwater of pH 5, what might occur to the population of GAMMARUS in a stream? To a population of GAMMARUS in a lake into which this stream flows? What if the water had a pH of 3?

REVIEW QUESTIONS:

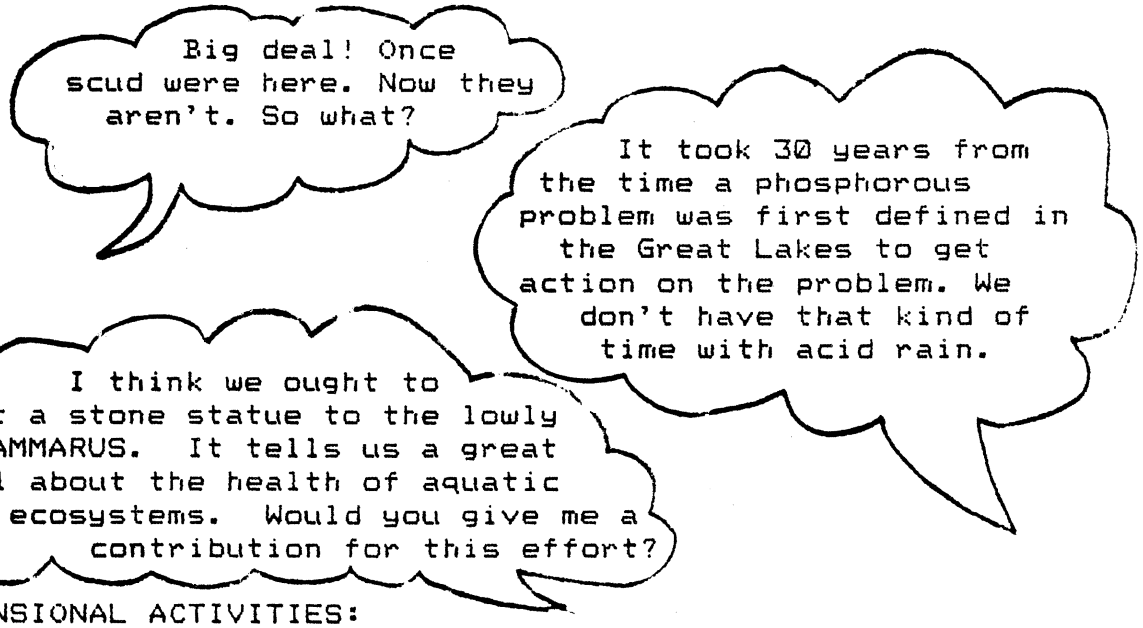
1. Ask students to interpret the following graph. What does it mean?



4.0 ----------
4.5 — · — · —
5.0 — · — · —
5.5 — — — —
6.0 ————————

Percent mortality of GAMMARUS adults exposed to indicated pH treatments in laboratory aquaria. Twenty adults, all over 1cm long, were used in each treatment.

2. Is it fair to say that it is likely that immature stages would be even more sensitive than adults? Why or why not?
3. What are some reasons that high elevation lakes (mountain lakes) might be more susceptible to the effects of acid rain than low elevation lakes?
4. Ask students to complete these sentence stems:
   Acid rain.....
   A skill I learned in this lab.....
   Animal life in lakes and streams depends.....
5. How would you respond?



EXTENSIONAL ACTIVITIES:
Have the students determine the pH of a local body of water or bring samples from other geographic areas they may

visit.

OPTIONAL ACTIVITIES:
Conduct an investigation of a nearby stream or river wherein organisms are collected, followed by a discussion of their limiting factors and the effect acid rain could have within their particular habitat.

*(Adopted from ACID PRECIPITATION AWARENESS, a Title IV-C ESEA Project begun in 1979. Harriett S. Stubbs, Project Director. This project was funded by ESEA Title IV, Part C, P.L. 95-561, with the Minnesota State Department of Education; the Freshwater Biological Research Foundation; Minnesota Sea Grant-Duluth; and the Minnesota Environmental Education Board.)

GAMMARUS ACTIVITY SHEET #1

Add 500ml of spring water to a container. Measure the pH of the spring water which should be approximately 6. Add 4 GAMMARUS to the container. If you have green algae available add it to the container.

GENERAL BEHAVIOR

Observe and record the behavior of GAMMARUS for 10-15 minutes. Where does it spend its time in the container? What percent of its time is spent moving? How does it spend its time? Does it use all of its legs in swimming? which ones are used in jumping and climbing? Do GAMMARUS avoid each other? What do they do when they "bump" into each other? How does it feed? (This is not easy to observe and a hand lens or microscope may have to be used if you decide to study this.)

GENERAL ANATOMY

GAMMARUS eat a wide variety of foods. Smear some baby food (spinach) on the bottom of a shallow container. Place the GAMMARUS and some pond water in this shallow container. If you have a steromicroscope/hand lens you will find them useful in viewing GAMMARUS "close up and personal".

1. Make as detailed a sketch of GAMMARUS as you can and label the parts: eyes, feelers, legs (Label the swimmer, jumper and crawler legs).
2. Observe and describe the feeding behavior of GAMMARUS.
3. If there is time try to learn more about GAMMARUS by touching it (gently) with a glass rod or toothpick. How sensitive is GAMMARUS to touch?

GAMMARUS ACTIVITY SHEET #2

1. Label six, 100ml containers, pH 1 to pH 5.

2. Add 100ml of the pH solutions to the containers as follows:
   a. Container 1 = 100ml pH 1 solution
   b. Container 2 = 100ml pH 2 solution
   c. Container 3 = 100ml pH 3 solution
   d. Container 4 = 100ml pH 4 solution
   e. Container 5 = 100ml pH 5 solution
   f. Container 6 = 100ml pH 6 solution (spring water)

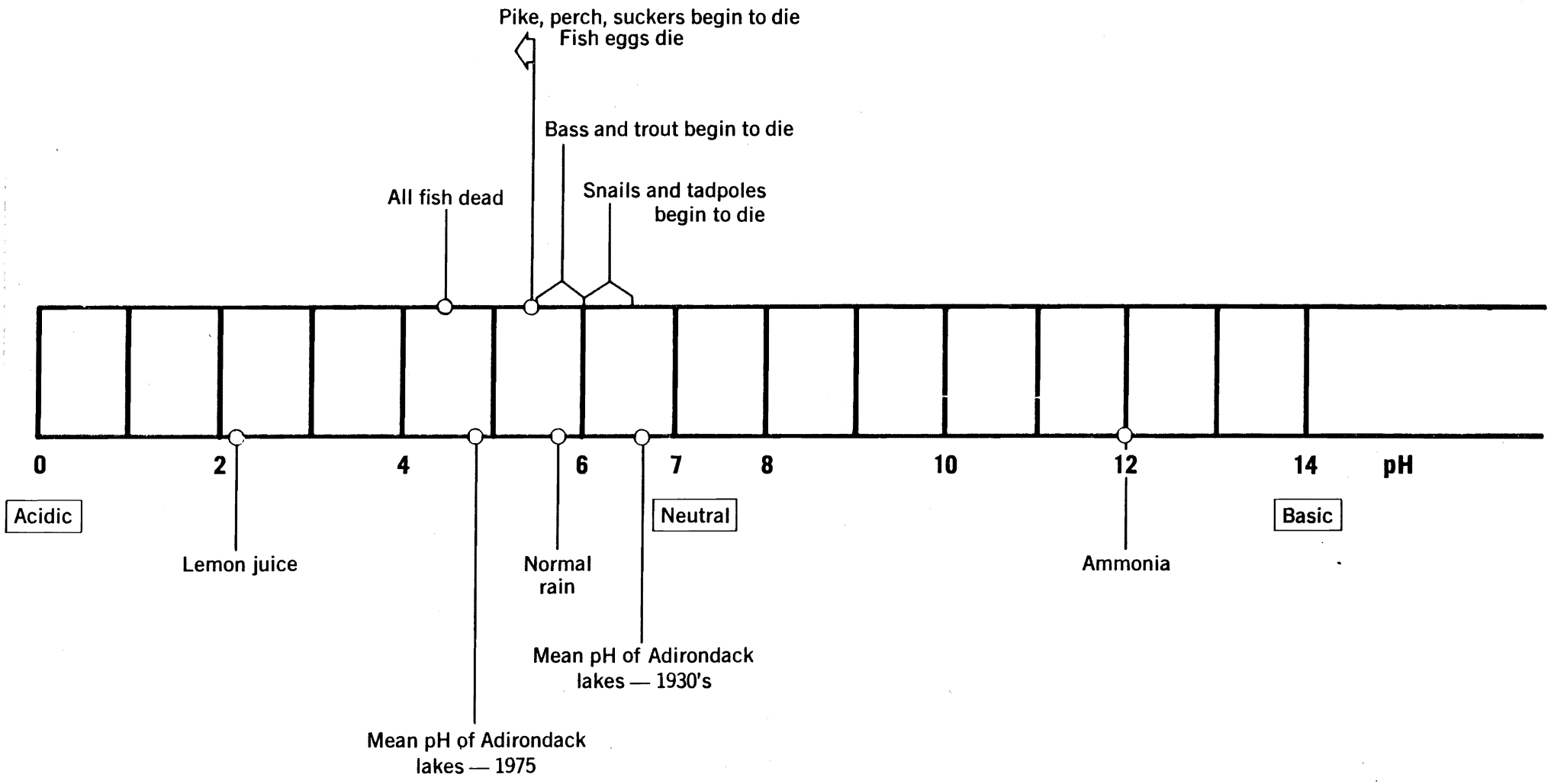
3. Check and record the pH in each container. The pH must be accurate. Your teacher can help you adjust it, if it is necessary.

4. Place two GAMMARUS in the pH 6 container. Record the time.

5. Place two GAMMARUS in the pH 1 solution. Record the time and your observations. You are familiar with GAMMARUS behavior. Is the behavior "normal" or is it new and different? Does GAMMARUS survive in this pH? If they die record the time.

6. Do this for pH 2,3,4,and 5.

The pH scale and acid rain



Source: West, "Acid from Heaven," Science News, 2/2/80

TITLE: Unit 5: Invertebrates
Day 9: What Have They Done To The Rain?*

GOAL LEVEL/ COMPONENTS:	Level II	Level III	Level IV
	A,B,D,E,F,G	A-H	A-D

COGNITIVE KNOWLEDGE CONCEPTS:
3,5-7,9,10,12,27-29,38,45,85.98.106

TOPICS: Environmental: Acid Rain

RESOURCES:

Articles:	#1,10,12,18
Other Pub:	#4
Books:	#5,6
AV:	#6

OBJECTIVES: The students will be able to:
-Identify the specific dilemma involved concerning acid lakes and jobs
-List consequences/effects of immediate and future solutions to the problem of acid rain
-Recite 2 actions that could be taken to help resolve the acid rain problem

MATERIALS: -several copies of the student reading (attached)

INTRODUCTION:

One of the results of Planet pHison's 0.80, 4-VII Star Search Space Exploration is the arrival of a new shipment of materials to the Environmental Documentation and Analysis Center (EDOC). You work with the Print Materials From Other Space Islands Group. Alystra, the section chief has asked you for an assessment of environmental conditions with special reference to the atmosphere on planet MW-H-III. She, of course, never says why, just get it done in two days and don't whine to me about lack of funds, time limitations, understaffing and other priorities. In a way, you half hope that you will discover nothing in the materials but the quick-scan computer (SYMSEARCH) spits out these images: atmosphere, pH, pollutants, environmental effects, and the reference: TIME, March 17, 1980. Now you have to do it. You feed the reference into the Decode-Recode computer system and push the print option button.

PROCEDURES

A. Distribute the student reading. Ask the students either individually or in small groups (3-5) to read it and to evaluate the evidence. Ask the students; "What does the evidence say?" or "What is going on there (on planet MW-H-III)?" These are some things you can ask them to do.

-What appear to be the main sources of the data?
-What are the main ideas?
-What examples of the ideas are given?
-What are the main conclusions?
-Are these conclusions substantiated by evidence?
-Where did the evidence come from? How good is it?
-What is the purpose of the article?
-Does the article represent one or more points-of-view? If so, what is it? What are they?
-What are the immediate effects, if any?
-What are the long-range effects, if any?
-Circle emotionally charged words or words which connote value judgments.
-Is the article a primary account or a secondary account, and, if the latter, on what is it based?
-What does the article say about the ways residents of MW-H-III treat/have treated the environment? The air of MW-H-III? The water of MW-H-III?
-Who appears to make decisions on MW-H-III about environmental treatment?
-What is/are the major concern(s) about the treatment of the environment?
-What are some of the influences on human life (Ask students to place items of data in prescribed categories), e.g.,
economic
political
social
geographic
legal
-Are any personal opinions expressed?
-What are the causes of the problem?
-What solutions are proposed? (Ask students to place items of data in prescribed categories)
economic
political
legal
scientific or technological
-What does Reynolds mean by such expressions as "What have they done..." or "...some smoke in..."?
-How does this problem seem to have occurred?
-What problems of regulation does the article suggest?
-Is there any evidence that in trying to solve the problem, residents of MW-H-III have made this situation better? Worse?

B. After students have translated the article ask them to write a short report, (this can be done by individual students or as a group) to the Supervisor, on the significance of what is going on or on what the data means to them. The report must include:
(1) What the data means to them and (2) answers to the following:

-What do you think of MW-H-III as a place to live?

-What predictions would you make for the future of this problem on MW-H-III? in 10 years? in 25 years? in 50 years? in 100 years?
-What effect do you think technology has had on MW-H-III and its people, wildlife and forests?
-Does this appear to be a problem that residents of MW-H-III can deal with? How might it be solved?
-Two possible actions that could be taken and at least one positive and negative effect of each.

CONCLUSION/REVIEW QUESTIONS:

1. Is acid rain one of the worst problems facing the world? Why? Why not? Which one(s) is (are) worst? Which are not as bad? How do you think these problems have occurred?
2. In the article some solutions to the acid rain problem are discussed. Did they make matters better or worse (or possible better and worse)?
3. The progress of technology confronts us with choices. Ask students to identify some of the choices in the acid rain article. What value conflicts do some of the choices represent?
4. Who should control actions such as potentially harmful emissions placed in the atmosphere that affects several countries? Who controls such actions now? What can be done about it? What are the advantages/disadvantages of these solutions?

EXTENSIONAL ACTIVITIES:
Have students take action on a particular environmental problem or issue of their choice, after which they will report their procedures and results.

OPTIONAL ACTIVITIES:
Have students investigate their community for situations which may be the result of a conflict between industry and environment such as that presented in the student reading. These issues may be local or may be national or even global problems that affect the local area.

*(Adopted from ACID PRECIPITATION AWARENESS, a Title IV-C ESEA Project begun in 1979. Harriett S. Stubbs, Project Director. This project was funded by ESEA Title IV, Part C, P.L. 95-561, with the Minnesota State Department of Education; the Freshwater Biological Research Foundation; Minnesota Sea Grant-Duluth; and the Minnesota Environmental Education Board.)

STUDENT READING

Acid From the Skies: Corrosive rain has become an insidious menace. (Source: Time Magazine, March 17, 1980).

Just a little breeze with some smoke in its eye,
What have they done to the rain?
Malvina Reynolds

Already it has killed off the fish in about a hundred lakes in New York's Adirondack wilderness. It has pelted the slopes of the Rockies, and has already affected Scandinavia and much of industrialized Western Europe and Japan. It is a newly recognized and increasingly harmful kind of pollution, invisible and insidious: acid rain, a corrosive precipitation that actually consists of weak solutions of sulfuric and nitric acids.

Last November 35 nations, including the U.S., gathered in Geneva and signed a pact pledging to work together against this skyborne peril. President Carter has authorized a $10 million annual outlay for a ten-year research program on acid rain, which he considers one of the two gravest environmental threats of the decade (the other: increasing levels of carbon dioxide in the atmosphere from the burning of fossil fuels).

Acid precipitation is apparently caused largely by sulfur dioxide emissions from coal-burning power plants, smelters and factories. To a lesser extent, nitrogen oxides from car exhausts and industry contribute to the problem. Rising high into the sky and borne hundreds of miles by winds, these chemicals mix and react with water vapor to form sulfuric and nitric acids. The acids then fall to earth in the form of rain or snow that can damage anything from monuments to living organisms. After a number of such rain showers or highly acidic snow melts, a lake's pH* can plunge low enough to impair the egg-producing ability of fish. Decomposition of organic matter slows, probably because of a loss of scavenging microorganisms. The number of plankton falls off sharply, depleting a vital link in the food chain. Finally, the water appears blue, clear - and virtually lifeless.

The ill effects spread beyond the lakes. In some areas, humans may also be affected. In the Lac la Croix lake system of Ontario, where the Ojibway Indians fish for their livelihood, catches are showing high levels of mercury. Reason: the toxic metal, ordinarily concentrated in sediment, changes into an organic form, methyl mercury, in acid water and is then easily absorbed by the fish. While the threat to plants is not as well understood, acid rain can eat away at leaves, leach nutrients from the soil, interfere with photosynthesis, and affect the nitrogen-fixing capabilities of such plants as peas and soybeans. Scandinavian scientists claim the rain has caused a 15% reduction in timber growth. It can also corrode stone statues, limestone buildings and metal rooftops. In the past two decades, Athens' Parthenon and Rome's Colosseum have deteriorated severely; the prime suspect is acid rain. In the U.S. it may cause as much as $2 billion each year in structural damage.

Paradoxically, one tactic in the fight against air pollution has contributed to the increase in acid rain. To keep the air clean in the immediate neighborhoods of factories, industry has been building ever taller smokestacks. These belch gases that are out of sight--and out of mind--for local communities, but not for those downwind. The farther the gases go, the more time they have to combine with moisture and form acids. Indeed, scientists estimate that the world's tallest stack, rising 1,250 ft. above a copper-nickel smelter in Sudbury, Ont., accounts for 1% of all sulfur emissions in the world, including those from volcanoes. All told, Canadian industry and the winds send about half a million tons of these emissions south to the U.S. every year.

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* pH is a scale, ranging from 0 to 14, for measuring acidity or alkalinity. A chemically neutral solution is denoted by 7, increasing acidity by lower numbers (each one representing a tenfold increase), and rising alkalinity by numbers greater than 7. Rain or snow has a natural pH around 5.6, resulting mainly from atmospheric

But Canada gets more than it gives. Some 2 million tons annually blow north across the border from the U.S., mostly from the industrial Ohio River Valley, which is also thought to be the main source of the Northeast's acid-rain problem. In Europe, says Svante Oden, a Swedish soil scientist, acid rain is equivalent to a "chemical war." Scandinavians claim they are being "bombed" by British and German factories, and similar charges have been exchanged by France and West Germany.

Written before any widespread alarm about acid precipitation, the U.S. Clean Air Act of 1970 gives states a liberal hand in controlling their own emissions to meet federal air quality standards. But it does not assign any responsibility for blights one state may inflict on another. The result has been a see-no-evil attitude that may well require more federal intervention. Also, the 1970 act sets standards only for "ambient," or ground-level air quality; acid rain is formed by high-floating emissions.

In some regions, nature itself buffers the effects of damaging rain; alkaline soils and rocks in the vicinity of the lake help neutralize the acidic water. But when man has tried to duplicate the process by spreading lime on and around endangered lakes, the task has proved expensive and only a temporary palliative.

Taking aim at the source of the trouble, the EPA is requiring the installation of scrubbers that remove up to 90% of sulfur emissions at all new coal-fired power plants. But older plants are not covered by the new law, and the problem is likely to worsen as the country turns increasingly to its vaunted ace in the energy hole, coal. "Washing" high-sulfur coal can help. This process involves crushing the coal, then separating out pyrite, an iron-sulfur compound. Because ash, dirt and rock are removed at the same time, washing also makes the coal more economical to ship and less damaging to utility boilers. Still, the expense of these measures is staggering. By one estimate, just to cut sulfur dioxide emissions by 50% in the Northeastern U.S. alone would cost up to $7 billion annually.

Yet even at such prices a solution may be a bargain. For as ecologists point out, doing nothing about acid rain now could mean nightmarish environmental costs in the future.

TITLE: Unit 5: Invertebrates
Day 10: Acid Rain: Two Views

GOAL LEVEL/ COMPONENTS:	Level II	Level III
	E,F	B,C

COGNITIVE KNOWLEDGE CONCEPTS:
#4,6,9,12,14,33,34,36,98

TOPICS: Environmental: Acid Rain

RESOURCES: Articles: #9,14,21,23,25
Other Pub: #7,8
AV: #6

OBJECTIVES: The students will be able to:
-Identify the problem to be discussed
-Identify factors which have an influence on the decision
-Recite their views with support assuming different character roles
-Describe alternative solutions to solving the problem

MATERIALS: -several copies of article #14, "Cleaning Up the Clean Air Act"

INTRODUCTION:

Tell the students,"a congressional hearing will be held today in this very classroom. Several of you will be assigned a character involved in an article which discusses the many viewpoints involved with the acid rain problem. You will be airing the opinions of the character whose role you will portray, at this hearing. The rest of you will be the congressional committee which will politely listen to all the views presented and will then make a final decision."

PROCEDURES

"After reading the article given you, you should be able to answer the question, "What is the problem that needs to be decided upon?" This will be the focus of our hearing today. Our judging panel will make a decision on whether or not regulations within the Clean Air Act need to be strengthened or relaxed. Those of you who are elected to play various character roles should be prepared to present your particular views on the future of the Clean Air Act."

Allow several minutes for the students to read the article.

"As the hearing comes to order, the students who are representing various companies and organizations will have a moment to express their views. After each is done the judging panel may ask them questions. After all the views are voiced the panel will need a few minutes to make their

decision. This hearing should be conducted in a formal manner."

Ask the students if they have any questions, then begin the hearing. Arrange desks and chairs in an appropriate manner.

CONCLUSION:

After the hearing, adjourn for a brief moment to allow the judging panel to come to a decision. Discuss the panel's decision.

REVIEW QUESTIONS:

1. What was the actual problem being discussed?
2. What are 2 solutions to the problem? What are the advantages/disadvantages to these solutions?

EXTENSIONAL ACTIVITIES

Given several sources of information, have students list ways in which we as individuals can help in resolving the acid rain puzzle.

OPTIONAL ACTIVITIES

Have students research and report on current environmental impacts and legislation regarding acid precipitation and the Clean Air Act.

APPENDIX M

SAMPLE APPENDICES

FOR AN ENVIRONMENTAL EDUCATION SUPPLEMENT

FOR MODERN BIOLOGY

SAMPLE APPENDIX I

GLOSSARY

GLOSSARY

Acid Rain:	A popular term used to describe precipitation which is more acidic than clean rain (which has a pH of less than 5.6).
Air Quality Standards:	Standards set by federal or provincial governments to control air pollution.
Buffer:	In soils or lakes, the ability to partially neutralize acidic precipitation.
Buffering capacity:	In soils or water bodies the degree to which they can offset acidification.
Combustion:	Any chemical action which occurs so rapidly that both noticeable heat and light are produced.
Ecosystems:	The complex of a plant and animal community and its environment functioning as an ecological unit in nature.
Emission:	Refers to substances discharged into the air (usually by human activities) such as through industrial smokestacks and automobile exhausts.
Fossil Fuels:	The remains of once-living animals and plants that are burned to release energy, e.g., coal, natural gas, and oil.
Interdependence:	The dependence of organisms upon other organisms for complete functioning.
Limiting Factors:	The materials an organism needs for growth and reproduction that determine where an organism can live and how well it can adapt to environmental change.
Long-Range Transport Of Air Pollutants (LRTAP):	Movement of pollutants through the atmosphere by winds over long distances (hundreds to thousands of kilometers).
Nitrous Oxide (NO):	A pollutant from car exhaust which forms nitrogen dioxide (NO_2) when combined with oxygen.

pH:	A scale used to measure the concentration of free hydrogen ions in solution, e.g., acidity or alkalinity. pH of less than 7 indicates acids, above 7 alkalines (or bases). A pH of 7 is neutral. The pH of "clean" rain is 5.6. This is due to the normal presence of carbon dioxide in the air which makes rain mildly acidic. Acidic precipitation is defined as precipitation with a pH of less than 5.6. Note the pH scale is logarithmic, i.e. a pH of 4.6 is ten times as acid as a pH of 5.6.
Precipitation:	Meteorological term referring to rain, snow, drizzle, hail, and ice pellets.
Sensitivity:	With regard to LRTAP, refers to the degree to which ecosystems potentially will be affected by air pollutants or the deposition of air pollutants.
Sulfur Dioxide (SO_2):	A gas pollutant which is a product of combustion which forms sulfuric acid (H_2SO_4) when combined with water.

SAMPLE APPENDIX II-A

CURRICULUM FRAMEWORK:

THE GOALS FOR CURRICULUM DEVELOPMENT

IN ENVIRONMENTAL EDUCATION

(The Goals for Curriculum Development in Environmental Education and their conceptual components are listed in Appendix A.)

SAMPLE APPENDIX II-B

CURRICULUM FRAMEWORK:
COGNITIVE KNOWLEDGE CONCEPTS
FOR ENVIRONMENTAL EDUCATION

Cognitive Knowledge Concepts for Environmental Education *

We perceive the major goal of environmental education to be an environmentally literate citizenry. The components of environmental literacy are identified in Chapter II as cognitive knowledge, cognitive process, and affect. The cognitive process and affect components are defined fully in that chapter. It is impossible to fully develop all of the dimensions of cognitive knowledge appropriate to environmental education in a single work of this nature. Those cognitive concepts dealing with ecological foundations and the population issue are developed in Chapters IV and V, respectively. To further expand the treatment of the cognitive knowledge component, the following list of concepts is provided as adapted from Robert E. Roth's "Fundamental Concepts for Environmental Management Education (K-16)."[27] It must be pointed out that while we feel the list to be a valuable aid in preparing environmental education materials, we do not perceive the listed concepts to represent the total cognitive structure for environmental education.

Concept No.	Concept
1.	Living things are interdependent with one another and their environment.
	Environmental Management
2.	Man has been a factor affecting plant and animal succession and environmental processes.
3.	The management of natural resources to meet the needs of successive generations demands long-range planning.
4.	Environmental management involves the application of knowledge from many different disciplines.
5	Modern man affects the structure of his environment.
6.	Aesthetic resources and recreational facilities of economic and noneconomic value are becoming increasingly important in leisure-time activities.
7.	Man has ability to manipulate and change the environment.
8.	A knowledge of the social, physical, and biological sciences and humanities is important for environmental understanding.
9.	Social and technological changes alter the interrelationships, importance, and uses for natural resources.
10	There are certain risks taken, and limitations experienced, when manipulating the natural environment.

11. Resource depletion can be slowed by the development and adoption of alternatives.

12. Environmental management has effects on individuals and social institutions.

13. Man's need for food, fiber, and minerals increases as populations expand and levels of consumption rise.

14. Conflicts emerge between private land use rights and the maintenance of environmental quality for the general public.

15. A cultural and time lag exists between the development of knowledge in science and technology and application of that knowledge to resource and environmental problems.

16. Management is the result of technical and scientific knowledge being applied in a rational direction to achieve a particular objective.

17. The management of natural resources is culture bound.

Management Techniques

18. Increased population mobility is changing the nature of the demands upon some resources.

19. Options available to future generations must not be foreclosed.

20. A variety of institutional structures are involved in planning and managing the environment.

21. Hunting regulations are useful in maintaining and restoring populations as well as in distributing the game harvest.

22. Multiple use is a practice in which a given land area functions in two or more compatible ways.

23. Management of habitat is considered to be an effective technique of wildlife management when the desire is to increase numbers of particular populations.

Environmental Education

24. Architecture can be one of the positively persuasive influences in developing a congenial environment.

25. Zoning is a practice in which land uses are prescribed based upon value judgments regarding the needs of society.

Economics

26. Ready transportation, growing interest, money surpluses, and increased leisure time combine to create heavy pressures on existing recreation facilities and demands for new ones.

27. Outdoor recreation is an increasingly important part of our culture and our economy.

28. The economy of a region depends on the utilization of its natural, human, and cultural resources and technologies over time.

29. Economic efficiency does not always result in conservation of a natural resource.

30. The distribution or location of resources in relation to population, technological and economic factors are critical to problems of resource conservation and use.

31. The political and economic strength of a country is in part, dependent upon its access to domestic and foreign resources and international relationships.

32. Conservation policy is determined by the interaction of science and technology; social and political factors; and aesthetic, ethical, and economic considerations.

33. Conventional benefit-cost analyses do not always result in sound conservation decisions.

34. A sound natural resource policy is dependent upon a flexible political system, pragmatically appraising and reappraising policies and programs in terms of their effect upon the public interest and in light of scientific knowledge about the natural resources.

35. Consumption practices are constantly being expanded by our ability to produce and create wants and market, which affects the rate of resource use.

36. Individuals tend to select short term economic gains, often at the expense of greater long term environment benefits.

37. Increasing population and per capita use of resources have brought changed land to man or resource to population ratios.

38. Goods and services are produced by the interaction of labor, capital, natural resources, and technology.

39. Long range planning for the use and allocation of natural and human resources is continually evolving.

40. Choices between needs (essentials) and wants or desires (nonessentials) are often in conflict.

41. Raw materials and energy supplies are generally obtained from those resources and places where they are available at least cost, usually in short economic terms.

42. Supply and demand, in relation to values held by society, determines what is a resource and its economic values.

43. The more efficient use of some resources is the result of technical and marketing improvements.

Environmental Problems

44. Safe waste disposal, including the reduction of harmful and cumulative effects of various solids, liquids, gases, radioactive wastes, and heat, is important if the well being of man and the environment is to be preserved.

45. Pollutants and contaminants are produced by natural and man-made processes.

46. Increasing human populations, rising levels of living and the resultant demands for greater industrial and agricultural productivity promotes increasing environmental contamination.

47. Natural resources are interdependent and the use of misuse of one will affect others.

48. In any environment, one component like space, water, air, or food may become a limiting factor.

49. Most resources are vulnerable to depletion in quantity, quality, or both.

50. The interaction of environmental and biological factors determines the size and range of species and populations.

51. Natural resources, water and minerals in particular, are unequally distributed with respect to land areas and political boundaries.

52. The renewable resource base can be extended by reproduction, growth, and management.

53. Natural resources affect and are affected by the material welfare of a culture and directly or indirectly by philosophy, religion, government, and the arts.

54. The natural environment is irreplaceable.

Adaptation and Evolution

55. An organism is the product of its heredity and environment.

56. Man is influenced by many of the same hereditary and environmental factors that affect other organisms and their populations.

57. The rate of change in an environment may exceed the rate of organism adaptation.

58. Organisms and environments are in constant change.

59. All living things, including man, are continually evolving.

60. The form of life present depends upon the coincidence of the life needs and their availability in an environment.

61. Biological systems are described as dynamic because the materials and energy involved are parts of continuous cycles; inorganic materials and energy become part of organic materials and are subsequently broken down into simpler substances and energy as a result of the operation of organic systems.

62. Animal populations are renewable resources.

63. Succession is the gradual and continuous replacement of one kind of plant or animal complex by another and is characterized by gradual changes in species composition.

Natural Resources

64. Water supplies, both in quantity and quality are important to all levels of living.

65. The earth and life on it are greatly affected by the atmosphere.

66. Water is a reusable and transient resource, but the available quantity may be reduced or quality impaired.

67. As populations increase competition for the use of water increases resulting in a need for establishing water use priorities.

68. The amount of precipitation that becomes available for use by man varies with topography, land use, and applied management practices.

(Minerals)

69. Mineral conservation involves the utilization of all known methods of using the minerals of the earth's crust that will cause them to serve more people for a longer time.

70. The nonrenewable resource base is considered finite.

71. Soil is classified as a renewable resource, but, because it may take a few years to thousands of years to be "renewed," it is more practically termed a depletable resource.

72. Minerals are nonrenewable resources.

73. Maintaining, improving, and in some cases restoring soil productivity is important to the welfare of people.

74. Geological processes like erosion and deposition modify the landscape.

75. Soil productivity can be maintained by utilizing known agronomic, mechanical, and chemical processes.

(Plants)

76. Green plants are the ultimate sources of food, clothing, shelter, and energy in most societies.

77. Plants are renewable resources.

78. Energy is supplied to an ecosystem by the activities of green plants.

(Animals)

79. Wildlife refuges, undisturbed natural areas, and preserves may be of value in protecting endangered species and perpetuating the gene pool.

80. Wildlife populations are important economically, aesthetically, and biologically.

81. Wildlife is considered to be a public resource.

The Socio-Cultural Environment

82. Man has responsibility to develop an appreciation of and respect for the rights of others.

83. Individual citizens should be stimulated to become well informed about resource issues, problems, management procedures, and ecological principles.

84. Conservation responsibilities should be shared by individuals, businesses and industries, special interest groups, and all levels of government and education.

85. Man has moral responsibility for environmental decisions.

86. Knowledge of the social structures, institutions, and culture of a society must be brought to bear on environmental considerations.

87. The relationships between man and the natural environment are mediated by culture.

88. Man is developing the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.

89. Social values and mores influence personal conservation behavior.

90. Public opinion constitutes a control over the use of conservation practices.

91. In a democracy, a basic theory is that increasing restrictions on resource allocation and use are imposed by the consent or insistence of the people.

Culture

92. The culture of a group is its learned behavior in the form of customs, habits, attitudes, institutions, and lifeways that are transmitted to its progeny.

93. Man has psychobiological and biosocial needs.

94. Human resources include the physical and mental abilities with which man is endowed and the knowledge man has generated.

95. Historically, cultures with high technological development have used more natural resources than those with lower levels of technological development.

Politics

96. Individual citizens should be stimulated to become active in the political process.

97. We have "legal" ownership of some resources like real estate and control over others during our lifetimes, but ethically we are "stewards" rather than owners of the resource base.

98. Policies, including natural resource policies, came about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.

99. Conservation policies are often the result of group action.

100. As populations increase and/or as resource supplies decrease, the freedom of individuals to use the resources as they wish decreases irrespective of the form of government.

The Family

101. Family planning and the limiting of family size are important if overpopulation is to be avoided and a reasonable standard of living assured for successive generations.

102. Individuals must develop their abilities to perceive if they are to increase their awareness and develop environmental perspective.

103. Individuals perceive different self-roles depending upon their positions in the social and environmental context.

104. Man has the capability of improving society through sociology, psychology, and science.

105. Man is a high animal form because of abilities to reason.

106. Man is continually developing an ethical base for making value judgments.

107. Man performs some tasks at a high physiological cost.

Psychological Aspects

108. Opportunities to experience and enjoy nature are psychologically rewarding to many and are important to mental health.

109. The need of man to turn inward for self renewal can be stimulated by external aesthetic experiences.

110. Resources have psychological impact on people.

111. Emotional reactions can be elicited by exposure to physical objects and geometric forms.

*(Borrowed with permission from Hungerford, H.R., and R. Ben Peyton. Teaching Environmental Education. Portland, Maine: J. Weston Walch. pp. 147-153. 1976.)

SAMPLE APPENDIX III

TOPIC INDEX

TOPIC INDEX

ENVIRONMENTAL TOPICS

BIOLOGICAL KNOWLEDGE

Chemical Basis of Life
Structural Basis of Life
The Cell and its Environment
Photosynthesis/Respiration
Cell Energy
Nucleic Acids/Protein Synthesis
Cell Growth and Reproduction
Heredity
Genetic Material
Genes and Human Populations
Applied Genetics
Organic Variation
Diversity of Life
Microbiology
Multicellular Plants
Invertebrates--Unit 5: Day #1,7-10
Vertebrates
Human Biology

ECOLOGICAL CONCEPTS

Adaptation
Biological Control
Biological Magnification
Biomes
Biosphere
Biotic/Abiotic Factors--Unit 5: Day #7
Biotic Potential
Carrying Capacity
Community
Conservation
Ecosystem--Unit 5: Day #7
Food Chain
Habitat--Unit 5: Day #7
Interdependence--Unit 5: Day #1,7
Limiting Factors--Unit 5: Day #1,7
Niche
Periodicity
Pollution
Population
Renewable/Nonrenewable Resources
Succession

SAMPLE APPENDIX IV

RESOURCES

RESOURCES
(Resource # refers to its bibliographic entry)

UNIT 1: THE NATURE OF LIFE

UNIT 2: THE CONTINUITY OF LIFE

UNIT 3: MICROBIOLOGY

UNIT 4: MULTICELLULAR PLANTS

UNIT 5: INVERTEBRATES

Activity: Values Continuum and Discussion--
Environmental Effects and Invertebrates

Articles:	#2, 19
Books:	#3, 4
Other Publications:	#1, 2, 3, 6
Audio-visual Materials:	#2, 3, 5, 7

Activity: Acid Rain: Its Causes and Effects

Articles:	#3, 4, 6, 7, 8, 13, 15, 19
Books:	#1,2
Other Pub:	#5
AV:	#1, 4

Activity: Am(pH)ipods: An Acid Test

Articles:	#11, 13, 16, 17, 20, 22, 24, 26
Books:	#6, 7, 8
AV:	#8

Activity: What Have They Done To The Rain?

Articles:	#1, 9, 12, 18
Books:	#5, 6
Other Pub:	#4
AV:	#6

Activity: Acid Rain: Two Views

Articles:	#10,14, 21, 23, 25
Other Pub:	#7, 8
AV:	#6

UNIT 6: VERTEBRATES

UNIT 7: HUMAN BIOLOGY

UNIT 8: ECOLOGICAL RELATIONSHIPS

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BIBLIOGRAPHY OF RESOURCES

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SAMPLE APPENDIX VI

PUBLISHERS

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AMERICAN SOCIETY OF AGRONOMY, 677 South Segoe Road, Madison, WI 53711
AMERICAN SOCIETY OF LANDSCAPE ARCHITECTS, 1750 Old Meadow Road, McLean, VA 22101
AMERICAN SOCIETY OF PLANNING OFFICIALS, 1313 East 60th Street, Chicago, IL 60637
AMERICAN WOOD COUNCIL, 1619 Massachusetts Avenue, NW, Washington, DC 20036
AMSCO SCHOOL PUBLICATIONS, INC., 315 Hudson Street, New York, NY 10013
ANCHOR BOOKS, Doubleday & Company, Inc., Garden City, NY 11530
APOLLO EDITIONS, 666 Fifth Avenue, New York, NY 10019
ARNO PRESS, 330 Madison Avenue, New York, NY 10017
ASSOCIATION FILMS, INC., 866 Third Avenue, New York, NY 10022

ATHENEUM PUBLISHERS, 122 East 42nd Street, New York, NY 10017
AVON BOOKS, 959 Eighth Avenue, New York, NY 10019
BALLANTINE BOOKS, Random House Distribution Center, Westminster, MD 21157
BANTAM BOOKS, INC., 666 Fifth Avenue, New York, NY 10019
A.S. BARNES & CO., INC., Forsgate Drive, Cranbury, NJ 08512
BARR FILMS, PO Box 5667, 3490 East Foothill Boulevard, Pasadena, CA 91107
BENEFIC PRESS, 10300 West Roosevelt Road, Westchester, IL 60153
BENNETT BOOKS, Chas. A. Bennett Co., Inc., 809 West Detweiller Drive, Peoria, IL 61614
BFA EDUCATIONAL MEDIA, 2211 Michigan Avenue, PO Box 1795, Santa Monica, CA 94046
THE BOBBS-MERRILL COMPANY, INC., 4300 West 62nd Street, Indianapolis, IN 46206
BONANZA (See CROWN)
BROWN UNIVERSITY PRESS, 71 George Street, Box 1881, Providence, RI 02912
BRITANNICA (see ENCYCLOPAEDIA BRITANNICA)
BUDEK FILMS (see HARVEST LABS)
BUREAU OF LAND MANAGEMENT, US Department of the Interior, Washington, DC 20240
BURGESS PUBLISHING CO., 7108 Ohms Lane, Minneapolis, MN 55435
CALIFORNIA REDWOOD ASSOCIATION, 617 Montgomery Street, San Francisco, CA 94111
CALIFORNIA STATE POLYTECHNIC UNIVERSITY, 3801 West Temple Avenue, Pomona, CA 91768
CALIFORNIA TOMORROW, Monadnock Building, 681 Market Street, San Francisco, CA 94105
CANADIAN CONSULATE GENERAL, Film Library, 310 South Michigan Avenue, Chicago, IL 60604
CARDINAL PRINTERS, INC., Teaching Aids/Games Division, Wesleyan University, Middletown, CT 06457
CAROUSEL FILMS, INC., 1501 Broadway, New York, NY 10036
CAXTON PRINTERS, LTD., Caldwell, ID 83605
CENTER FOR ADVANCED COMPUTATION, University of Illinois, Urbana, IL 61801
THE CENTER FOR HUMANITIES, INC., Two Holland Avenue, White Plains, NY 10603
CENTER FOR SCIENCE IN THE PUBLIC INTEREST, 1779 Church Street, NW, Washington, DC 20036
CENTRON EDUCATIONAL FILMS, 1621 West Ninth Street, Lawrence, KS 66044
CHILDRENS PRESS, 1224 West Van Buren Street, Chicago, IL 60607
CHURCHILL FILMS, 662 North Robertson Boulevard, Los Angeles, CA 90069
CLIFFS NOTES, INC., PO Box 80728, Lincoln, NB 68501
COLLIER (see MACMILLAN)
COLLINS WORLD, 2080 West 117th Street, Cleveland, OH 44111
COLOPHON (see HARPER & ROW)
COMSTOCK EDITIONS, INC., 3030 Bridgeway Boulevard, Sausalito, CA 94965
CONSERVATION & ENVIRONMENTAL STUDIES CENTER, INC., Box 2230, RD7, Browns Mills, NJ 08015
THE CONSERVATION FOUNDATION, 1717 Massachusetts Avenue, NW, Washington, DC 20036

CONTEMPORARY/MCGRAW-HILL FILMS, Princeton Road, Hightstown, NJ 08520
CORNELL UNIVERSITY FILM LIBRARY, 31 Roberts Hall, Cornell University, Ithaca, NY 14853
CORONET INSTRUCTIONAL MEDIA, 65 East South Water Street, Chicago, IL 60601
COWARD, MCCANN & GEOGHEGAN, INC., PO Box 50, East Rutherford, NJ 07073
DOROTHY A. COX, 30808 Lamar, Farmington Hills, MI 48024
CREATIVE EDUCATIONAL SOCIETY, 123 South Broad Street, Mankato, MN 56001
CREATIVE LEARNING, 19 Market Street, Warren, RI 02885
CROWELL (Apollo Editions), 666 Fifth Avenue, New York, NY 10019
CROWELL-COLLIER (see MACMILLAN)
THOMAS Y. CROWELL COMPANY, INC., 666 Fifth Avenue, New York, NY 10019
CROWN (Bonanza), Crown Publishers, Inc., 1 Park Avenue, New York, NY 10016
CROWN ZELLERBACH, 1500 SW First Avenue, Portland, OR 97201
DAMON/EDUCATION DIVISION, 80 Wilson Way, Westwood, MA 02090
JOHN DAY, Division of Thomas Y. Crowell, 666 Fifth Avenue, New York, NY 10019
DELL PUBLISHING CO., INC., 1 Dag Hammarskjold Plaza, 245 East 47th Street, New York, NY 10017
DENOYER-GEPPERT, 5235 Ravenswood Avenue, Chicago, IL 60640
DEVIN-ADAIR COMPANY, INC., 143 Sound Beach Avenue, Old Greenwich, CT 06870
THE DIAL PRESS, 1 Dag Hammarskjold Plaza, 245 East 47th Street, New York, NY 10017
DODD, MEAD & COMPANY, INC., 79 Madison Avenue, New York, NY 10016
DOUBLEDAY & COMPANY, INC., Garden City, NY 11530
DOVER PUBLICATIONS, INC., 180 Varick Street, New York, NY 10014
DROLL YANKEES INC., Mill Road, Foster, RI 02825
E.P. DUTTON & CO., INC., 201 Park Avenue South, New York, NY 10003
EASTMAN KODAK COMPANY, 343 State Street, Rochester, NY 14650
ERIC Information Analysis Center for Science, Mathematics, and Environmental Education, The Ohio State University, 1200 Chambers Road, Columbus, OH 43210
EDISON ELECTRIC INSTITUTE, 90 Park Avenue, New York, NY 10016
EDUCATION DEVELOPMENT CENTER, 15 Mifflin Place, Cambridge, MA 02138
EDUCATION VENTURES (see CARDINAL PRINTERS)
EDUCATIONAL DEVELOPMENT CORPORATION (see IMPERIAL EDUCATIONAL RESOURCES)
EDUCATIONAL MODULES, INC., Merrell Scientific Division, 1665 Buffalo Road, Rochester, NY 14624
ENCYCLOPAEDIA BRITANNICA Educational Corporation, 425 North Michigan Avenue, Chicago, IL 60611
ENERGY & MAN'S ENVIRONMENT, 0224 SW Hamilton, Portland, OR 97201
ENVIRONMENTAL ACTION COALITION, 235 East 49th Street, New York, NY 10017
ESSENTIA, PO Box 129, Tiburon, CA 94920
M. EVANS & CO., INC., 216 East 49th Street, New York, NY 10017
EXPOSITION PRESS, INC., 800 Oyster Bay Road, Hicksville, NY 11801

EYE GATE MEDIA, 146-01 Archer Avenue, Jamaica, NY 11435
FARRAR, STRAUS & GIROUX, INC., 19 Union Square, New York, NY 10003
FAWCETT WORLD LIBRARY, 1515 Broadway, New York, NY 10036
J.G. FERGUSON PUBLISHING COMPANY, 111 East Wacker Drive, Chicago, IL 60601
FILMS INCORPORATED, 1144 Wilmette Avenue, Wilmette, IL 60091
STUART FINLEY, 3428 Mansfield Road, Falls Church, VA 22041
RON FINNE, Filmmaker, 36526 Jasper Road, Springfield, OR 97477
FOLLETT PUBLISHING CO., 1010 West Washington Boulevard, Chicago, IL 60607
FOREST HISTORY SOCIETY, INC., PO Box 1581, Santa Cruz, CA 95061
FOREST SERVICE, USDA, Films, National Audio-Visual Center, Sales Branch (GSA), Washington, DC 20409, or regional film libraries of the Forest Service
FORUM PRESS, PO Box 915, St. Charles, MO 63301
W.H. FREEMAN & CO., 660 Market Street, San Francisco, CA 94104
FRIENDS OF THE EARTH, 529 Commercial Street, San Francisco, CA 94111
FRIENDSHIP PRESS, 475 Riverside Drive, New York, NY 10027
FUNK & WAGNALLS CO., THOMAS Y. CROWELL, 666 Fifth Avenue, New York, NY 10019
GAMES CENTRAL-ABT ASSOCIATES INC., 55 Wheeler Street, Cambridge, MA 02138
GEORGIA-PACIFIC CORPORATION, 900 SW Fifth Avenue, Portland, OR 97204
GARRARD PUBLISHING COMPANY, 1607 North Market Street, Champaign, IL 61820
GOLDEN BOOKS, Western Publishing Company, Inc., 1220 Mound Avenue, Racine, WI 53404
GOLDEN GATE, Division of Childrens Press, 1247½ North Vista Street, Los Angeles, CA 90046
GOLDEN PRESS (see WESTERN PUBLISHING COMPANY)
GOODHEART-WILLCOX, 123 West Taft Drive, South Holland, IL 60473
STEPHEN GREENE PRESS, PO Box 1000, Fessenden Road, Indian Flat, Brattleboro, VT 05301
GROSSET & DUNLAP, INC. Publishers, 51 Madison Avenue, New York, NY 10010
GROSSMAN PUBLISHERS, Division of Viking Press, 625 Madison Avenue, New NY 10022
GROUP FOR ENVIRONMENTAL EDUCATION INC., 1214 Arch Street, Philadelphia, PA 19107
GROVE PRESS, INC., 196 West Houston Street, New York, NY 10014
GSA, General Services Administration, National Audio-Visual Center, Washington, DC 20409
GUIDANCE ASSOCIATES, 757 Third Avenue, New York, NY 10017
GULL LAKE ENVIRONMENTAL EDUCATION PROJECT, Kellogg Bird Sanctuary, 12685 East C Avenue, Augusta, MI 49012
HAFNER (see MACMILLAN)
HARCOURT BRACE JOVANOVICH, INC., 757 Third Avenue, New York, NY 10017
HARPER & ROW, PUBLISHERS, INC., Keystone Industrial Park, Scranton, PA 18512
HASTINGS HOUSE PUBLISHERS, INC., 10 East 40th Street, New York, NY 10016
HARVARD UNIVERSITY PRESS, Cambridge, MA 02138

HARVEST LABORATORIES, Pelham Street, Newport, RI 02840
HARWELL ASSOCIATES, Box 95, Convent Station, NJ 07961
HAWTHORN BOOKS, 260 Madison Avenue, New York, NY 10016
HEARTHSIDE PRESS INC., 445 Northern Boulevard, Great Neck, NY 10021
D.C. HEATH AND COMPANY, 125 Spring Street, Lexington, MA 02173; Distribution Center, 2700 North Richardt Avenue, Indianapolis, IN 46219
EDWARD HINES LUMBER CO., Post Office Box 191, Laramie, WY 82070
HOLIDAY HOUSE, 18 East 53rd Street, New York, NY 10022
HOLT, RINEHART AND WINSTON, INC., 383 Madison Avenue, New York, NY 10017
HOUGHTON MIFFLIN COMPANY, (for games, Department M), 1 Beacon Street, Boston, MA 02107
HUBBARD SCIENTIFIC CO., Box 104, Northbrook, IL 60062
IMPERIAL EDUCATIONAL RESOURCES (Division of Educational Development Corporation), PO Box 5500, 202 Lake Miriam Drive, Lakeland, FL 33803
INDIANA UNIVERSITY, Audio-Visual Center, Bloomington, IN 47401
INQUIRY AUDIO VISUALS, 1754 West Farragut Avenue, Chicago, IL 60640
INSTRUCTIONAL AIDS, INC., PO Box 191, Mankato, MN 56001
INSTRUCTIONAL SIMULATIONS, INC., 2147 University Avenue, St. Paul, MN 55114
THE INSTRUCTOR PUBLICATIONS, INC., Dansville, New York, NY 14437
INTERACT, PO Box 262, Lakeside, CA 92040
INTERNATIONAL FILM BUREAU INC., 332 South Michigan Avenue, Chicago, IL 60604
INTERNATIONAL UNION for Conservation of Nature and Natural Resources, 1110 Morges, Switzerland
IOWA DEPARTMENT OF PUBLIC INSTRUCTION, Curriculum Division, Grimes State Office Building, Des Moines, IA 50319
JENNY PUBLISHING COMPANY, INC., 57 Queen Avenue South, Minneapolis, MN 55405
JOHNNY HORIZON NEWS BUREAU, Johnny Horizon Program, Washington, DC 20240
THE JOHNS HOPKINS UNIVERSITY PRESS, Baltimore, MD 21218
JOURNAL FILMS, INCORPORATED, 930 Pitner Avenue, Evanston, IL 60202
JURSNICK PRINTING CO., Great Falls, MT 59401
WILLIAM KAUFMAN, INC., 1 First Street, Los Altos, CA 94022
KEEP AMERICA BEAUTIFUL, INC., 99 Park Avenue, New York, NY 10016
ALFRED A. KNOPF, INC., Subsidiary of Random House, Inc., 201 East 50th Street, New York, NY 10022
JOHN KNOX PRESS, 341 Ponce de Leon Avenue, NE, Atlanta, GA 30308
LANE COUNTY IED, Environmental Management Services, 135 East Sixth Avenue, Eugene, OR 97401
LANE PUBLISHING CO., Willow & Middlefield Roads, Menlo Park, CA 94025
LEAGUE OF WOMEN VOTERS of the United States, 1730 M Street, NW, Washington, DC 20036
LEARNING GAMES ASSOCIATES, 1490 South Boulevard, Ann Arbor, MI 48014
J.B. LIPPINCOTT COMPANY, East Washington Square, Philadelphia, PA 19105
LITTLE, BROWN AND COMPANY, 34 Beacon Street, Boston, MA 02106

LITTON EDUCATIONAL PUBLISHING, INC., 300 Pike Street, Cincinnati, OH 45202
LOTHROP (see MORROW)
LYCEUM PRODUCTIONS, INC., PO Box 1018, Laguna Beach, CA 92652
MACMILLAN PUBLISHING CO., INC., Front and Brown Streets, Riverside, NJ 08075
MASSACHUSETTS AUDUBON SOCIETY, Hatheway Environmental Education Institute, Lincoln, MA 01773
MCCLAIN PRINTING COMPANY, 212 Main Street, Parsons, WV 26287
MCGRAW-HILL BOOK COMPANY, 8171 Redwood Highway, Novato, CA 94947
MCGRAW-HILL BOOK COMPANY, 1221 Avenue of the Americas, New York, NY 10020
MCGRAW-HILL FILMS (see CONTEMPORARY/MCGRAW-HILL)
DAVID MCKAY CO., INC., 750 Third Avenue, New York, NY 10017
JULIAN MESSNER, Division of Simon & Schuster, Inc., 1 West 39th Street, New York, NY 10018
METROPOLITAN LIFE, 1 Madison Avenue, New York, NY 10010
MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC., 5400 Glenwood Avenue, Minneapolis, MN 55422
THE MIT PRESS, Massachusetts Institute of Technology, 28 Carleton Street, Cambridge, MA 02142
MODERN LIBRARY (see RANDOM HOUSE)
MODERN TALKING PICTURE SERVICE, 2323 New Hyde Park Road, New Hyde Park, NY 11040
KITTY MORGAN, NO. 9, 37 Spring Street, New York, NY 10012
WILLIAM MORROW & COMPANY, INC., 105 Madison Avenue, New York, NY 10010
NATIONAL ACADEMY OF SCIENCES, 2101 Constitution Avenue, NW, Washington, DC 20418
NATIONAL ARCHIVES AND RECORDS, General Services Administration, Washington, DC 20408
NATIONAL ASSOCIATION OF BIOLOGY TEACHERS, 11250 Roger Bacon Drive, Reston, VA 22090
NATIONAL ASSOCIATION OF STATE FORESTERS, Department of Natural and Economic Resources, PO Box 27687, Raleigh, NC 27611
NATIONAL AUDIO-VISUAL CENTER, Sales Branch GSA, Washington, DC 20409
NATIONAL AUDUBON SOCIETY, 950 Third Avenue, New York, NY 10022
NATIONAL FOREST PRODUCTS ASSOCIATION, 1619 Massachusetts Avenue, NW, Washington, DC 20036
NATIONAL PARK SERVICE, U.S. Department of the Interior, Washington, DC 20240
NATIONAL PARKS & CONSERVATION ASSOCIATION, 1701 18th Street, NW, Washington, DC 20009
NATIONAL SCIENCE TEACHERS ASSOCIATION, 1742 Connecticut Avenue, NW, Washington, DC 20009
NATIONAL WILDLIFE FEDERATION, 1412 16th Street, NW, Washington, DC 20036
NATURAL HISTORY PRESS (see DOUBLEDAY)
NEW AMERICAN LIBRARY, 1301 Avenue of the Americas, New York, NY 10019
NORTH CAROLINA STATE UNIVERSITY, School of Forest Resources, Raleigh, NC 27607
NORTHWEST PULP AND PAPER ASSOCIATION, 555 116th Avenue, NE, Bellevue, WA 98004
W.W. NORTON & COMPANY, INC., 500 Fifth Avenue, New York, NY 10036

NOVA, Public TV Library, Videoprogram Service, 475 L'Enfant Plaza West, SW, Washington, DC 20027
F.M. O'BRIEN BOOKSELLER, 34 & 36 High Street, Portland, ME 04101
OPEN LANDS PROJECT, 53 West Jackson Boulevard, Chicago, IL 60604
DIVISION OF CONTINUING EDUCATION, Audiovisual Instruction, 1633 Southwest Park Avenue, Portland, OR 97201
OREGON HISTORICAL SOCIETY, 1230 Southwest Park Avenue, Portland, OR 97205
DEPARTMENT OF FORESTRY, State of Oregon, 2600 State Street, Salem, OR 97310
OREGON STATE UNIVERSITY, School of Forestry, Corvallis, OR 97331
OUTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES (OBIS), Lawrence Hall of Science, University of California, Berkeley, CA 94720
OUTDOOR PICTURES, PO Box 277, Anacortes, WA 98221
OXFORD UNIVERSITY PRESS, INC., 200 Madison Avenue, New York, NY 10016
PANTHEON BOOKS DIVISION, Random House, Inc., 201 East 50th Street, New York, NY 10022
PARENTS' MAGAZINE PRESS, 52 Vanderbilt Avenue, New York, NY 10017
PARKER PUBLISHING COMPANY, INC., West Nyack, NY 10994
PEGASUS (see BOBBS-MERRILL)
PELICAN PUBLISHING CO., INC., 630 Burmaster Street, Gretna, LA 70053
PENGUIN BOOKS, INC., 625 Madison Avenue, New York, NY 10022
PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES, DIVISION OF FOREST PEST MANAGEMENT, 34 Airport Drive, Harrisburg International Airport, Middletown, PA 17057
PERENNIAL EDUCATION, INC., PO Box 236, 1825 Willow Road, Northfield, IL 60093
PERGAMON PRESS, INC., Maxwell House, Fairview Park, Elmsford, NY 10523
PHOTO LAB, INC., 3825 Georgia Avenue, Washington, DC 20011
PICTURA FILMS DISTRIBUTION CORPORATION, 43 West 16th Street, New York, NY 10011
PRAEGER PUBLISHERS, INC., 111 Fourth Avenue, New York, NY 10003
PRENTICE-HALL, INC., Englewood Cliffs, NJ 07632
PROFESSIONAL EDUCATORS PUBLISHERS INC., PO Box 80728, Lincoln, NB 68501
PROJECT LEARNING TREE, PO Box 129, Tiburon, CA 94920
PUBLIC SERVICE COMPANY OF COLORADO, 550 15th Street, Denver, CO 80201
PUBLIC TELEVISION LIBRARY, Videoprogram Service, 475 L'Enfant Plaza West, SW, Washington, DC 20027
G.P. PUTNAM'S SONS, Coward, McCann & Geoghegan, 200 Madison Avenue, New York, NY 10016
PYRAMID (see HARCOURT BRACE JOVANOVICH)
RAND MCNALLY & COMPANY, PO Box 7600, Chicago, IL 60680
RANDOM HOUSE, INC., 400 Hahn Road, Westminster, MD 21157
REED & SONS, Box 250, Route 2, Perrysville, OH 44864
HENRY REGNERY CO., 180 North Michigan Avenue, Chicago, IL 60601
RESTON (see PRENTICE-HALL)
RIO GRANDE PRESS, INC., Glorietta, NM 87535
ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION, Forest Service, USDA, Fort Collins, CO 80521
RODALE PRESS, INC., Emmaus, PA 18049
THE RONALD PRESS COMPANY, 79 Madison Avenue, New York, NY 10016
ST. MARTIN'S PRESS, INC., 175 Fifth Avenue, New York, NY 10010
ST. REGIS PAPER COMPANY, 150 East 42nd Street, New York, NY 10017
SCHOCKEN BOOKS, INC., 200 Madison Avenue, New York, NY 10016

SCHOLASTIC BOOK SERVICES, 50 West 44th Street, New York, NY 10036
CHARLES SCRIBNER'S SONS, 597-599 Fifth Avenue, New York, NY 10017
THE SEABURY PRESS, INC., 815 Second Avenue, New York, NY 10017
SENTRY (see HOUGHTON MIFFLIN)
SHELTER PUBLICATIONS (see RANDOM HOUSE)
SHOREY PUBLICATIONS, 110 Union Street, Seattle, WN 98111
SIERRA CLUB, 530 Bush Street, San Francisco, CA 94108
SILVER BURDETT COMPANY, 250 James Street, Morristown, NJ 07960
SIMON & SCHUSTER, INC., 630 Fifth Avenue, New York, NY 10020
SINAUER ASSOCIATES, INC., Sunderland, MA 01375
SINGER EDUCATION DIVISION, 1345 Diversey Parkway, Chicago, IL 60614
PETER SMITH, 6 Lexington Avenue, Gloucester, MA 01930
SOCIETY FOR VISUAL EDUCATION INC., 1345 Diversey Parkway, Chicago, IL 60614
SOCIETY OF AMERICAN FORESTERS, 5400 Grosvenor Lane, Bethesda, MD 20014
SOIL CONSERVATION SOCIETY OF AMERICA, 7515 NE Ankeny Road, Ankeny, IA 50021
SOIL SCIENCE SOCIETY OF AMERICA, American Society of Agronomy, 677 South Segoe Road, Madison, WI 53711
SOUTHERN BAPTIST RADIO-TELEVISION COMMISSION, Box 12157, Fort Worth, TX 76116
SOUTHERN FOREST INSTITUTE, 3395 NE Expwy, #380, Atlanta, GA 30341
SOUTHERN FOREST PRODUCTS ASSOCIATION, PO Box 52468, New Orleans, LA 70152
STACKPOLE BOOKS, PO Box 1831, Harrisburg, PA 17105
STAY AWAY JOE, Publishers, PO Box 2054, Great Falls, MT 59401
STERLING PUBLISHING CO., INC., 419 Park Avenue South, New York, NY 10016
SUPERINTENDENT OF DOCUMENTS, U.S. Government Printing Office, Washington, DC 20240
THE SWALLOW PRESS, INC., 811 West Junior Terrace, Chicago, IL 60613
TEACHING RESOURCES FILMS, An Educational Service of the New York *Times*, 2 Kisco Plaza, Mt. Kisco, NY 10549
TECOLOTE PRESS, INC., PO Box 217, Glenwood, NM 88039
TERRA SOCIETY, PO Box 110, Mount Prospect, IL 60056
THRESHOLD BOOKS, 365 Martha Street, Susanville, CA 96130
TROLL ASSOCIATES, 320 Route 17, Mahwah, NJ 07430
TROUBADOR PRESS, 385 Fremont Street, San Francisco, CA 94105
U.S. DEPARTMENT OF THE INTERIOR, Washington, DC 20240
U.S. FOREST SERVICE, Department of Agriculture, Washington, DC 20250
U.S. GOVERNMENT PRINTING OFFICE, Washington, DC 20240
UNIVERSITY OF ARIZONA, Bureau of Audiovisual Services, University of Arizona, Tucson, AZ 85721
COOPERATIVE EXTENSION, U.S. Department of Agriculture, University of California, Berkeley, CA 94720
UNIVERSITY OF CALIFORNIA, College of Natural Resources, Department of Forestry and Conservation; and Division of Agricultural Sciences, Berkeley, CA 94720
UNIVERSITY OF CALIFORNIA, Extension Media Center, Berkeley, CA 94720
UNIVERSITY OF CALIFORNIA PRESS, 2223 Fulton Street, Berkeley, CA 94720
FORESTRY LIBRARY, University of California, Berkeley, CA 94720
THE UNIVERSITY OF CHICAGO PRESS, 11030 South Langley Avenue, Chicago, IL 60628

UNIVERSITY OF ILLINOIS PRESS, Urbana, IL 61801
UNIVERSITY OF MICHIGAN, Audio-Visual Education Center, 416 Fourth Street, Ann Arbor, MI 48109
THE UNIVERSITY OF MICHIGAN, Television Center, 400 Fourth Street, Ann Arbor, MI 48103
UNIVERSITY OF MISSOURI PRESS, 107 Swallow Hall, Columbia, MO 65201
UNIVERSITY OF NEBRASKA PRESS, 901 North 17th Street, Lincoln, NB 68588
UNIVERSITY OF OKLAHOMA PRESS, 1005 Asp Avenue, Norman, OK 73069
UNIVERSITY OF SOUTHERN CALIFORNIA, Film Distribution Center, Division of Cinema, University Park, Los Angeles, CA 90007
UNIVERSITY OF TEXAS PRESS, Box 7819, University Station, Austin, TX 78712
UNIVERSITY OF WASHINGTON PRESS, Seattle, WA 98105
UNIVERSITY OF WISCONSIN PRESS, Box 1379, Madison, WI 53701
VAN NOSTRAND REINHOLD CO., Division of Litton Educational Publishing Inc., 300 Pike Street, Cincinnati, OH 45202
THE VIKING PRESS, INC., 625 Madison Avenue, New York, NY 10022
VISUAL EDUCATION, INC., PO Box 6039, Santa Barbara, CA 93111
VOCATIONAL EDUCATION PRODUCTIONS, California State Polytechnic University, San Luis Obispo, CA 93401
VOCATIONAL GUIDANCE MANUALS, 620 South Fifth Street, Louisville, KY 40202
WADSWORTH PUBLISHERS, INC., 10 Davis Drive, Belmont, CA 94002
HENRY Z. WALCK, INC., Division of David McKay, 750 Third Avenue, New York, NY 10017
WALKER & CO., 720 Fifth Avenue, New York, NY 10019
WALT DISNEY FILMS, distributed by Association Films, Inc.
FREDERICK WARNE AND CO., INC., 101 Fifth Avenue, New York, NY 10003
WASHINGTON STATE DEPARTMENT OF PUBLIC INSTRUCTION, Old Capitol Building, Olympia, WA 98504
WASHINGTON STATE UNIVERSITY, Audio-Visual Center, Pullman, WA 99163
WATSON-GUPTILL PUBLICATIONS, INC., 1 Astor Plaza, New York, NY 10036
FRANKLIN WATTS, INC., 730 Fifth Avenue, New York, NY 10019
WEBSTER/MCGRAW-HILL (see MCGRAW-HILL)
WEST WIND PUBLICATIONS, INC., PO Box 3532, Boulder, CO 80303
WESTERN PUBLISHING COMPANY, INC., 1220 Mound Avenue, Racine, WI 53404
WESTERN WOOD PRODUCTS ASSOCIATION, 1500 Yeon Building, Portland, OR 97204
WESTMINSTER, Room 905, Witherspoon Building, Philadelphia, PA 19107
WEYERHAEUSER COMPANY, Box A, Tacoma, WA 98401
ALBERT WHITMAN AND CO., 560 West Lake Street, Chicago, IL 60606
WIFF'N PROOF (see LEARNING GAMES ASSOCIATES)
WILDLIFE MANAGEMENT INSTITUTE, 709 Wire Building, 1000 Vermont Avenue, NW, Washington, DC 20005
JOHN WILEY & SONS, INC., 605 Third Avenue, New York, NY 10016
WINSTON PRESS, 25 Groveland Terrace, Minneapolis, MN 55403
WORLD (see COLLINS WORLD)
WORLDWATCH INSTITUTE, 1776 Massachusetts Avenue, NW, Washington, DC 20036
YALE UNIVERSITY PRESS, 302 Temple Street, New Haven, CT 06511

SAMPLE APPENDIX VII

GUIDELINES FOR REQUESTING

INFORMATION AND ASSISTANCE

GUIDELINES FOR REQUESTING INFORMATION AND ASSISTANCE *

BE SPECIFIC

Your chances of obtaining useful information will be greatly increased if you state exactly which materials you need, which issues interest you, or what questions you want answered. The accompanying bibliography was developed to help you be specific in your requests. The "send everything you have" approach is uneconomical and unecological.

AVOID CLASS-WIDE REQUESTS

Limit requests for information from any single source to one or two students and pool the collected data. If you cannot avoid a situation where many students ask for similar information, send all the requests in one envelope and ask that materials returned be mailed in one package to one address.

REQUEST ONLY WHAT YOU NEED

. . . and use what you get.

TRY LOCAL SOURCES FIRST

Many community and regional agencies, organizations, and industrial associations can provide valuable information and assistance, particularly on local issues and conditions. Your school librarian or your public library can also help locate information available.

SEND A SELF-ADDRESSED, STAMPED ENVELOPE

If you request material or information from volunteer organizations, include a self-addressed, stamped envelope. This will bring a quicker response because these organizations have very limited budgets and secretarial staffs.

PLAN ON TWO TO THREE WEEKS OF LEAD TIME

If you plan to use the material, such as a pamphlet or film, in conjunction with an activity, send your request *at least* two or three weeks ahead of time.

MAKE SPEAKER REQUESTS WELL IN ADVANCE

Most state agencies and volunteer organizations cannot afford to send their staff or members great distances to speak to one class. However, many resource agencies will assign personnel to meet with students on field trips near their field stations or offices. Most often, the educational experience provided by the presentation in the field is superior to a formal speech in the classroom.

SAMPLE APPENDIX VIII

ADDRESSES FOR ADDITIONAL INFORMATION AND MATERIAL

ADDRESSES FOR ADDITIONAL INFORMATION AND MATERIAL*

Citizen Conservation Organizations

AMERICAN FORESTRY ASSOCIATION, 1319 - 18th Street, N.W., Washington DC 20036, publishes *American Forests* (monthly periodical)

BOONE AND CROCKETT CLUB, C/O Carnegie Museum, 4400 Forbes Avenue, Pittsburgh, PA 15213

THE CONSERVATION FOUNDATION, 1717 Massachusetts Avenue, N.W., Washington DC 20036, publishes the *C F Letter* (monthly newsletter)

COUNCIL ON ECONOMIC PRIORITIES, 456 Greenwich Street, New York, NY 10013

DEFENDERS OF WILDLIFE, 2000 N Street N.W., Washington DC 20036, publishes *Defenders of Wildlife News* (newsletter)

DUCKS UNLIMITED, P.O. Box 66300, Chicago, IL 60666, publishes *Ducks Unlimited Magazine*

ENVIRONMENTAL ACTION, INC., Room 731, 1346 Connecticut Avenue N.W., Washington DC 20036, publishes *Environmental Action* (bi-monthly newsletter)

ENVIRONMENTAL DEFENSE FUND, INC., 162 Old Town Road, East Setauket, NY 11733

FOREST HISTORY SOCIETY, INC., P.O. Box 1581, Santa Cruz, CA 95060, publishes *Forest History* (quarterly)

FRIENDS OF THE EARTH, 529 Commercial Street, San Francisco, CA 94111, publishes *Not Man Apart* (bi-monthly newspaper)

IZAAK WALTON LEAGUE OF AMERICA, 1800 North Kent Street, Arlington, VA 22209, publishes *Outdoor America*

LEAGUE OF CONSERVATION VOTERS, 620 C Street, S.E., Washington DC 20003

LEAGUE OF WOMEN VOTERS OF THE U.S., 1730 M Street N.W., Washington DC 20036, publishes *The National Voter*

NATIONAL AUDUBON SOCIETY, 950 Third Avenue, New York, NY 10022, publishes *Audubon* (monthly periodical)

NATIONAL PARKS AND CONSERVATION ASSOCIATION, 1701 - 18th Street, N.W., Washington DC 20009, publishes *National Parks & Conservation Magazine* (monthly periodical)

NATIONAL WILDLIFE FEDERATION, 1412 - 16th Street N.W., Washington DC 20036, publishes *National Wildlife, Ranger Rick,* (magazines) and *Conservation News* and *Conservation Report* (newsletters)

NATURAL RESOURCES COUNCIL OF AMERICA, Suite 911, 1025 Connecticut Avenue N.W., Washington DC 20036

THE NATURE CONSERVANCY, Suite 800, North Kent Street, Arlington, VA 22209

SCIENTISTS' INSTITUTE FOR PUBLIC INFORMATION, 438 North Skinker, St. Louis, MO 63130, publishes *Environment* (monthly periodical)

SIERRA CLUB, 1050 Mills Tower, San Francisco, CA 94104, publishes *Sierra Club Bulletin* (monthly periodical) and *National News Report* (weekly newsletter)

SOIL CONSERVATION SOCIETY OF AMERICA, 7515 N.E. Ankeny Road, Ankeny, IA 50021, publishes the *Journal of Soil and Water Conservation* (monthly)

SPORT FISHING INSTITUTE, Suite 503, 719 - 13th Street N.W., Washington DC 20005, publishes the *S F I Bulletin* (monthly newsletter)

TROUT UNLIMITED, 4260 East Evans Avenue, Denver, CO 80222, publishes *Trout Magazine*

WESTERN FORESTRY AND CONSERVATION ASSOCIATION, 1326 American Bank Building, Portland, OR 97205

THE WILDERNESS SOCIETY, 729 - 15th Street N.W., Washington DC 20005, publishes *The Living Wilderness* (monthly periodical)

WILDERNESS WATCH, P.O. Box 3184, Green Bay, WI 54303

WILDLIFE MANAGEMENT INSTITUTE, 709 Wire Building, Washington DC 20005, publishes *Outdoor News Bulletin*

WORLD WILDLIFE FUND, Suite 619, 910 - 17th Street N.W., Washington DC 20006

ZERO POPULATION GROWTH, INC., 343 Second Street, Los Angeles, CA 94022, publishes *Equilibrium* (periodical) and *National Reporter* (newsletter)

For a more extensive listing of conservation organizations, see *The Conservation Directory:* (Washington D.C.: National Wildlife Federation)

Forest Industry Associations

AMERICAN FOREST INSTITUTE, 1619 Massachusetts N.W., Washington DC 20036, publishes *Green America*

AMERICAN PAPER INSTITUTE, 260 Madison Avenue, New York, NY 10016

AMERICAN PLYWOOD ASSOCIATION, 1119 A Street, Tacoma, WA 98401

AMERICAN PULPWOOD ASSOCIATION, 605 Third Avenue, New York, NY 10006

AMERICAN WOOD COUNCIL, 1619 Massachusetts N.W., Washington DC 20036

CALIFORNIA FOREST PROTECTIVE ASSOCIATION, 1127 - 11th Street, Suite 534, Sacramento, CA 95814

CALIFORNIA REDWOOD ASSOCIATION, 617 Montgomery Street, San Francisco, CA 94111

INDUSTRIAL FORESTRY ASSOCIATION, 1220 S.W. Columbia Street, Portland, OR 97201
NATIONAL FOREST PRODUCTS ASSOCIATION, 1619 Massachusetts N.W., Washington DC 20036
REDWOOD REGION CONSERVATION COUNCIL, 224 Roseburg Building, Santa Rosa, CA 95404
SOUTHERN FOREST INSTITUTE, 3395 Northeast Expressway, Suite 380, Atlanta, GA 30341
WESTERN WOOD PRODUCTS ASSOCIATION, 1500 Yeon Building, Portland, OR 97204

Forest Industry Companies

BOISE CASCADE CORPORATION, P.O. Box 50, Boise, ID 83728
CROWN-ZELLERBACH CORPORATION, One Bush Street, San Francisco, CA 94119
EDWARD HINES LUMBER COMPANY, P.O. Box 191, Laramie, WY 82070
GEORGIA-PACIFIC CORPORATION, 900 S.W. Fifth Avenue, Portland, OR 97204
INTERNATIONAL PAPER COMPANY, P.O. Box 579, Longview, WA 98632
POTLATCH CORPORATION, Box 3591, San Francisco, CA 94119
SCOTT PAPER COMPANY, P.O. Box 925, Everett, WA 98201
SIMPSON TIMBER COMPANY, 900 Fourth Avenue, Seattle, WA 98164
SOUTHWEST FOREST INDUSTRIES, 3443 N. Central Avenue, P.O. Box 7548, Phoenix, AZ 85011
ST. REGIS PAPER COMPANY, 150 East 42nd Street, New York, NY 10017
WEYERHAEUSER COMPANY, Tacoma, WA 98401

Professional Societies

SOCIETY OF AMERICA FORESTERS, Wild Acres, 5400 Grosvenor Lane, Bethesda, MD 20014, publishes the *Journal of Forestry*
THE WILDLIFE SOCIETY, Suite 611, 7101 Wisconsin Avenue, N.W., Washington, DC 20014, publishes the *Journal of Wildlife Management* and *Wildlife Society News*

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