THE EFFECTS OF AN OUTDOOR MYSTERY GAME ON FOURTH GRADE STUDENTS' ENVIRONMENTAL EDUCATION

By

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CHAPTER I

INTRODUCTION

Background

The environment has been a global concern for educators and environmentalists alike. As vital ecosystems are being destroyed, the health of the planet is threatened. The field of environmental education may become one of the most important fields of teaching for this reason (Hewitt, 1997). Environmental educators know that the future of the planet's state of health depends on how well future generations are educated about human impacts on the environment.

The goal of environmental education today is to change behavior toward the environment (Asch and Shore, 1975; Hewitt, 1997; Hines et al., 1986; Hungerford and Volk, 1990; Knapp et al., 1997; Maloney et al., 1975; Newhouse, 1990). In the past, educators felt that providing knowledge about environmental problems would accomplish that goal (Hungerford and Volk, 1990), however, studies have shown that knowledge alone is not sufficient in changing behavior (Hines et al., 1986; Klinger, 1980). To be effective in changing behavior, environmental education programs must combine knowledge with skill in applying that knowledge to take action in issues (Hines et al., 1986).

Studies have also shown that people with positive attitudes toward the environment are more likely to take action toward protecting the environment (Shepard and Speelman, 1985; Tanner, 1980). Therefore, in order to be

effective in changing behavior toward the environment, educational programs must provide knowledge about environmental problems, skills to take action, and the opportunity for positive experiences in the outdoors to develop positive attitudes.

Statement of the Problem

Many studies of environmental education have been done with adults and older students, but very few have been done on younger children (Hewitt, 1997; Jaus, 1982). Since children develop most of their political and social attitudes between the fourth and fifth grades (Jaus, 1982), this is the optimal time to help children develop positive environmental attitudes. The "Riddle of the Woods" program at Oxley Nature Center (ONC) demonstrates the research-based criteria which provide an effective type of environmental educational program for fourth grade students. It is hoped that this study will demonstrate the positive impacts of the "Riddle of the Woods" program on fourth grade students' environmental knowledge, attitudes, and behavior.

Significance of Study

The field of environmental education is relatively new, so methods of teaching environmental education are still being discovered. The research has found that students need to make connections with the outdoors before environmental education can be successful (Asch and Shore, 1975; George, 1967). Therefore, teachers need to provide students with opportunities for those outdoor connections.

However, a dull, guided nature walk outdoors does not always work either. Students, especially from urban environments like Tulsa, are generally

lost in a nature setting. They are not able to make the desired connections because many of them have never been in the woods before (Kostka, 1976). Environmental education needs to provide students with positive outdoor experiences. Students who experience the outdoors in a positive way are more likely to care about it, more likely to want to learn more about how to take care of it, and more likely to act positively toward it. There is a need for a method of environmental education that takes all of these factors into account. There is a need for a program that is successful in the cognitive, affective, and behavioral domains.

If the program being examined in this study is shown to be effective, it could potentially begin a new type of environmental education that has not yet been explored. Environmental educational outdoor mystery games are not common, but have the potential to be extremely useful. Games have many benefits for children as has been proved in research for years (Boocock and Schild, 1968; Erickson, 1963; Hewitt, 1997; Magney, 1989; Piaget and Inhelder, 1969). Research also shows that children who are given opportunities to have positive experiences in the outdoors develop positive attitudes and positive behaviors toward the outdoors (Dresner and Gill, 1994). Teaching environmental education in the classroom alone is not working. It does not serve the ultimate purpose of environmental education as most environmental educators see it--to change behavior toward the environment. It is hoped that this program will demonstrate all the elements an environmental education program needs to succeed.

Hypotheses

The hypotheses to be tested in this study are that there is no difference within or between groups on pretest and posttest scores in the knowledge, attitude, or behavior subscales of the test at the 0.05 level of significance. Groups consist of two control groups and two treatment groups.

Scope of Study

This study examined a particular environmental educational program called The "Riddle of the Woods". It is a program written and designed by the staff of Oxley Nature Center (ONC), which is run by Tulsa Parks and Recreation in Tulsa, Oklahoma. It was written specifically for fourth grade students, and is unique in that ONC is the only place the program is used. The entire program is taught by trained staff and volunteer naturalists from ONC.

Two different treatment schools of fourth graders were tested for any changes in their environmental attitudes, behavior, or knowledge after going through the program. Their scores were compared to two control schools of fourth graders not having any exposure to the program.

Delimitations

The study was delimited by the following:

1. Only fourth grade students were used in the study.
2. Students from only Tulsa Public Schools were used.
3. The testing instrument measured only environmental knowledge, behavior, and attitudes related to the teaching objectives of the "Riddle of the Woods" program.

4. Only those subjects with parental permission to participate in the study were used.

Limitations

The study was limited by the following:

1. Four schools of fourth grade students were the subjects in the study for convenience. This limited randomness.
2. Teachers of treatment groups signed up to participate in the program at least a year ago. These teachers may have more interest in the environment than teachers in the control group. This may have had an uncontrollable effect on subjects' test scores.
3. The "Riddle of the Woods" program is specific in that it teaches students about
a particular ecosystem. This limits generalizability.

Assumptions

The following basic assumptions were accepted:

1. Subjects understood directions and answered test questions honestly and to the best of their abilities.
2. The staff naturalists running the program at the center were well-trained.
3. Teachers of the subjects did not help subjects prepare for the tests, or alter their regular curriculum for any purposes related to this study.

Definitions

The following terms are specifically defined as given when used in this study:

Attitude: "an enduring positive or negative feeling about some person, object, or issue" (Newhouse, 1990).

Environmental education: "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 knowledge, attitudes, motivations, commitments and skills to work individually and collectively toward solutions of current problems and the prevention of new ones" (Stapp, 1978).

Participant: fourth grade students from Tulsa Public Schools participating in the "Riddle of the Woods" program and this study.

Some Ideas: an environmental attitude testing instrument (Likert scale) divided into four subscales to measure upper elementary school students' environmental attitudes (Horvat and Voelker, 1976).

CHAPTER II

REVIEW OF LITERATURE

Environmental education goals

Before beginning to create environmental education curricula, educators must first develop some goals or objectives. They are necessary to properly design educational programs. Without goals, there is no focus. In 1975, Vande Visse and Stapp warned that "without a clear statement of goals, an environmental education program would become a series of unrelated experiences, focusing on limited program objectives."

Looking at the development of environmental educational objectives over the years, it is interesting to note that the ultimate goal of environmental education has not changed a great deal from its inception. The goal has always been some form of behavior change toward the environment. Behavior change, some would argue, is the goal of all education, not just environmental education (Asch and Shore, 1975; Hungerford and Volk, 1990). Guilbert (1981) wrote in the *Educational Handbook for Health Personnel* that "(T)he object of education is not to shape citizens to the uses of society, but to produce citizens able to shape a better society." Asch and Shore (1975) wrote:

"One of the great challenges in all education is to demonstrate that an educational program can result in positive changes in what students do, not only in what they write on a test. This is especially true in environmental education."

In 1969, Stapp proposed that environmental education should try to create citizens who are knowledgeable concerning the biophysical environment and its problems, aware of how to solve these problems, and motivated to help solve them. An emphasis on behavior as the ultimate goal of environmental education was present right from the beginning. The objectives for environmental education as identified by the Tbilisi Intergovernmental Conference on Environmental Education in 1977 were similar. They were as follows:

1. Awareness--to help individuals become sensitive to the environment and its issues.
2. Sensitivity--to help individuals understand the environment and its problems through a variety of experiences.
3. Attitudes--to help individuals develop feelings of concern for the environment and motivation to aid in environmental improvement.
4. Skills--to help individuals learn skills for identifying and solving environmental problems.
5. Participation--to provide individuals with an opportunity for involvement in all levels of environmental problem-solving.

These goals were to become the "guiding light" for many environmental educators (McCrea and Weaver, 1984). Using these objectives, an environmentally responsible person can be defined as one who has awareness and sensitivity to the environment, an understanding of the issues, feelings of concern for the environment, and the skills and motivation for solving environmental problems. An environmentally responsible person is also defined as one who is involved in environmental problem-solving. The focus of environmental education as defined by the Tbilisi Conference was behavior

change achieved through making the citizen aware of environmental issues, and giving them the knowledge they need to understand the environment. Knowledge leads to attitude, which then leads to behavior change, which is the ultimate goal.

In 1980, Hungerford et al. presented a "superordinate goal" for environmental education. It was "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." Once again, the emphasized outcome was behavior change.

Hines et al. (1986) defined the goals of environmental education as "the development of environmentally responsible and active citizens." They also stated that knowledge alone cannot influence environmental protection. In a 1987 UNESCO document, environmental education was defined as a model of action in which "individuals and the community gain awareness of their environment and acquire the knowledge, values, skills, experiences and also the determination which will enable them to act--individually and collectively--to solve present and future environmental problems." Behavior change and environmental action are emphasized.

Children are the target group of most educational programs. Hewitt (1997) placed an emphasis on children as being important in achieving the objectives of environmental education. She wrote that encouraging children to actively participate in protecting the environment is one way the critical balance may be maintained. Confucius wrote the following about educating children:

If your plan is for 1 year,

plant rice;

if your plan is for 10 years,

plant trees;

if your plan is for 100 years,

educate children.

Models and Philosophies of Environmental Education

Defining educational objectives is generally the easiest part of designing curriculum. The difficult part is creating the best program to meet those objectives. This usually involves trial and error, program modification, and eventually trial and success. While the objectives of environmental education have not changed much over the years, the models of the best methods of achieving those objectives have.

It was first believed that behavior change could be achieved by making the public aware of environmental issues. The logic was that if educators made people more knowledgeable, they would become more aware of environmental problems, and would then be more motivated to act in an environmentally responsible manner (Hungerford and Volk, 1990).

But then studies came out demonstrating that knowledge was only slightly related to behavior. Lingwood found that an individual's level of concern for the environment was much more important in choosing to attend an environmental program than the individual's environmental knowledge (Lingwood, 1974).

The models then began to link knowledge with behavior through attitude change. The following model, developed by Ramsey and Rickson in 1977, was

a widely accepted model of environmental education: "[I]ncreased knowledge leads to favorable attitudes. . . which in turn lead to actions promoting better environmental quality" (Hungerford and Volk, 1990). This behavior change model was simple, and involved only three parts:

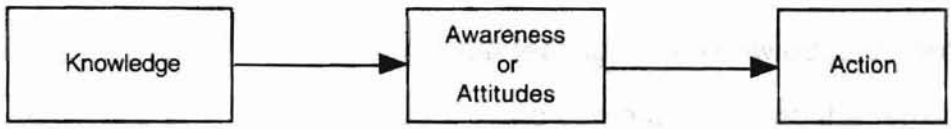

Figure 1. Behavior Change Model, Ramsey and Rickson, 1977.

In 1978, Stapp proposed a three-part method of achieving the goal of environmental education:

1. understand that people are a part of the environmental system and that their actions both harm and benefit the surroundings.
2. understand how environmental problems can be solved and recognize each individual's responsibility.
3. develop skills for understanding, preventing, and correcting environmental problems.

Both of these three-part models are simple, and both begin with knowledge. However, Stapp's model includes teaching skills to correct environmental problems, while the Ramsey and Rickson model does not. Teaching skills was discovered to be an important part of the education process.

One study revealed that programs involving both knowledge of environmental issues combined with skill components to solve environmental problems resulted in more environmental action (Klinger, 1980). Skill in environmental problem-solving, combined with knowledge, was thought to give individuals what they needed to take positive action.

However, Hines et al. (1986) stated that knowledge and skills alone were not sufficient to lead to environmental action. There also had to be the desire to act. This desire involved environmental attitudes. Borden and Schettino (1979) in their study of college psychology students' environmental knowledge and attitudes (as related to behavior), wrote that feelings and knowledge showed no correlation. They also discovered that feelings and knowledge do not interact in determining environmental actions and commitment, and that environmental feelings were more important in determining environmental action than level of knowledge.

Another model for environmental education that has been developed was created by Hines et al. (1986). It suggests a more complex model for environmental education, and takes many more factors into account than the previous models:

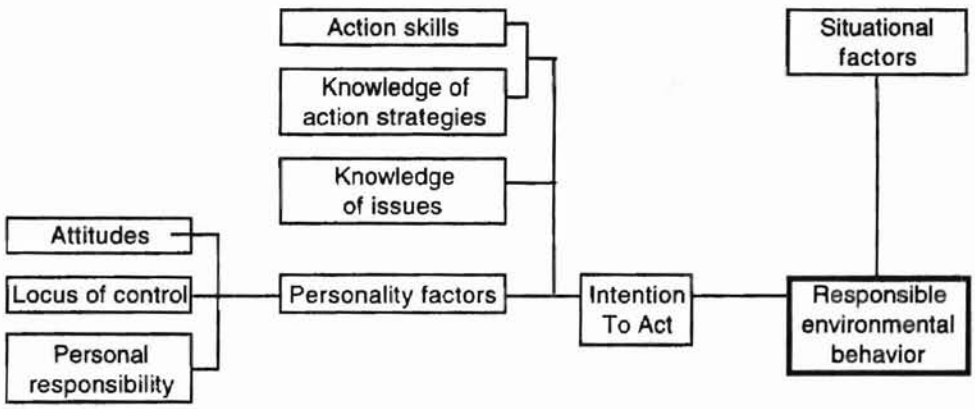

Figure 2. Behavior Change Model, Hines et al., 1986.

The model demonstrates that there is more to environmental education than just knowledge, attitude, and behavior. Attitudes, combined with locus of control and personal responsibility, all influence the personality of an individual. That personality combined with action skills, and knowledge (both of issues and of strategies for action), all influence the person's intention to act. Other factors

that influence the decision to act are situational factors, such as social pressures or economic restraints.

Hungerford and Volk (1990) used the Hines et al. model to create a behavior flow chart demonstrating the different variables that affect behavior change. This model is more linear than the Hines et al. model, though it takes into account the fact that not every person will be affected by every factor.

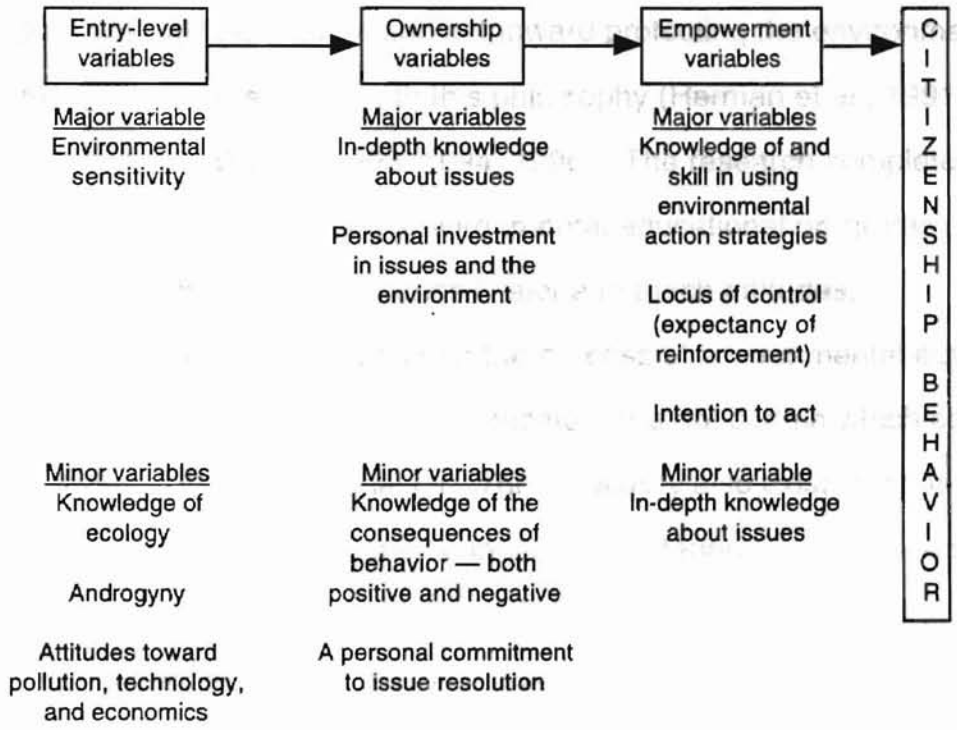

Figure 3. Behavior Change Model, Hungerford and Volk, 1990.

In the Hines et al. model, all factors influence the decision to act. In the Hungerford and Volk model, these factors (called variables) are weighted according to their importance in influencing behavior (major and minor variables). It is also clear that while a person does have to go through a linear progression (entry-level, ownership, then empowerment), not all these factors need to be present before environmental behavior can occur.

Although the previously mentioned educators would agree that some type of knowledge does have to be taught for environmental education to occur, one prominent environmental writer does not. Rachel Carson, in her essay "A Sense of Wonder," (1965), wrote that when teaching children about the natural world, it is not the knowledge that is important, but fanning the flame of curiosity that is inherent in children. If this curiosity is encouraged, children will grow up to be adults who will care about and act toward protecting the environment. Many other researchers agree with this philosophy (Herman et al., 1991; Stapp, 1978; Tilbury, 1994; Wilson, 1993, 1994, 1996). The research completed for this thesis revealed no studies of environmental educational programs that used this philosophy of utilizing curiosity alone to teach attitudes.

The research demonstrates that the process of environmental education is heavily debated. Researchers and educators are not certain which comes first: knowledge, attitude, or behavior. The possibility also exists that all three aspects of environmental education can work simultaneously, and need not be divided into three distinct steps. However, since these three aspects are all important in environmental educational research, that research will be examined in detail.

Knowledge

Although knowledge of the environment and its problems is generally believed to be a prerequisite to environmental action, knowledge alone cannot influence the protection of the environment (Hines et al., 1986). Does the teaching of environmental knowledge need to occur before attitudes and behavior can change?

Opinions were varied. Carson (1965), Herman et al. (1991), and Wilson (1993, 1994, 1996) would say 'little, if any.' A poll taken in 1992 by Peter D. Hart Research Associated stated that although the environment was the highest-ranked issue cited by young people looking toward the future, and although these same young people were more environmentally motivated than their parents, their knowledge and understanding of environmental issues was limited (Fuller, 1992). This poll demonstrated an interesting point: knowledge is not essential for environmental awareness, positive environmental attitudes, and motivation for environmental action. Students may only know that there are "problems," may have a limited understanding of some of those problems, but still feel motivated to act in a positive manner toward the environment.

However, limited knowledge of environmental problems can also be troublesome, even if people have positive environmental attitudes. For example, this researcher has encountered citizens on "Ozone Alert" days in Oklahoma who will not go outdoors without hats or sunscreen. Obviously this is a misunderstanding of the ozone problems, confusing the problem of too little ozone in the stratosphere with too much ozone near the ground (Freedman, 1995).

Attitudes

Environmental attitudes have been getting much attention in the study of environmental education--everything from how they are formed to how they should best be taught. "Environmental attitudes are a person's feelings about his role in the complex, interrelated biosphere" (Kostka, 1976). A positive environmental attitude, by this definition, would cause a person to see him/herself as a part of the natural world, feel responsible for environmental

problems, and make conscientious choices affecting the environment (Dubos, 1968; Glacken, 1970). Knapp (1972) outlined several different methods for changing attitudes:

1. verbal reinforcement--praising a student expressing a favorable attitude.
2. counter-attitudinal role playing--students pretend to have attitudes opposite from their own to expand their perceptions of situations.
3. debates--students defend two sides of an issue.
4. providing new information--research has shown, according to Knapp, that this is sometimes successful, and sometimes not.
5. introducing anxiety or fear arousing situations--too much fear is not successful, but mild fear can sometimes change attitudes.
6. understanding the psychological need for holding a particular attitude--after the need is understood, dependency on the need can be altered.
7. changing certain social factors--laws, for example, can change attitudes.
8. adult models--adults surrounding children affect their attitudes (Knapp noted that before any environmental instruction takes place, the teacher must clarify his/her own attitudes).
9. behavior change precedes attitude change--involvement in action projects results in attitude change.

So in theory, a program utilizing one or more of these techniques for changing attitudes in children would result in the desired attitude change. It is the ninth technique that has been used as a basis for environmental educational research recently. Hewitt (1997) stated that involving students in their communities to actively solve local environmental problems encouraged them to become active on a global level. She believed this was because

teaching students only facts and concepts did not have a large effect on changing students' attitudes. Getting them involved, however, did.

Many other studies have demonstrated this same phenomenon. Students have to be taught how to care for something before they will want to protect it. Research has also shown that many attitudes are fixed by the time a student reaches high school, so environmental instruction should take place in the elementary and/or middle school in order to establish positive environmental attitudes (Knapp, 1972). However, one study revealed an interesting finding: by the time students were in the fifth grade, they had already developed positive environmental attitudes, even without any formal instruction in the subject (Jaus, 1982).

Researchers have noted something else about attitudes: that what people say their attitudes are and what they actually are may not be the same (Jaus, 1982; Moyer, 1977). With this in mind, testing attitudes is recognized as a difficult process.

Behavior

Although education and environmental education in particular point to behavior as being the ultimate goal, the research revealed few studies of programs with behavior tested. Most of the studies tested knowledge, attitude, socialization, or self-concept after participating in environmental educational programs. This could be because behavior is difficult to test. A person may say they behave in a certain way, but they actually behave differently. To actually test a person's real behavior, the tester would have to observe the subject's behavior constantly, which for most research is simply not possible.

Environmental education is often closely linked to interpretation of natural resources, the goal of which is also behavior change. Some educators say that environmental education and interpretation are so similar, it is difficult to separate them (Hammitt, 1981; Mullins, 1984; Sharpe, 1982). "Environmental interpretation can and should influence visitors' attitudes or behavior toward the use of natural resources" (Knapp et al., 1997). The natural resources mentioned should include those within the interpretive site as well as those outside of the site, so that visitors carry what they learn with them and apply it to their daily lives (Biggs and Roth, 1986; Brown, 1971; Field and Wager, 1973; Mackintosh, 1986; Mahaffey, 1973; McAvoy and Hamborg, 1984; National Forest Service, 1991; National Park Service, 1991; Sharpe, 1982; Tilden, 1957). However, the field of environmental interpretation, like environmental education, lacks framework for the development of programs designed to change behavior (Knapp et al., 1997).

Informal v. formal education

Environmental education has had many problems in discovering the best method of teaching. The reason for this is because the environmental movement, like other movements, was based more on intuition and love than on scientific method; so environmental education has had a lack of research in methodology (Werling, 1979). Both formal and informal methods of education make a definite contribution and should be seen as compatible instead of competitive (McCrea and Weaver, 1984). There is much disagreement among environmental educators about which instructional approach is more beneficial to the student and the environment. Some educators believe that basic concepts are more important to teach than issue-oriented, problem-solving

practices. Others think it is more useful to teach the problem-solving techniques, as that will accomplish the goal of behavior change faster than simply teaching basic concepts of the environment (McCrea and Weaver, 1984). However, with budget restrictions as a constant concern for educators and administrators, there is increasing reluctance to fund informal environmental education programs without more evidence of success (McCrea and Weaver, 1984).

There are many different learning theories and definitions about what constitutes learning. Cronbach's definition states that learning is a change in behavior as a result of an experience (1954). Another definition emphasizes learning as a process in which one discovers how to relate to people, things, and ideas (Pittenger and Gooding, 1971). Still another states that learning is the development of a self that can handle reality (Kidd, 1959). One common thread in learning theories is behavior change toward a person's social and physical environment.

Informal education has been advocated as an excellent method for teaching all subjects for years. Although there is not one all-encompassing definition of what informal education is, there is a general consensus on what it is not. Educators agree that informal education is not formal classroom activities in schools (formal being traditional, one-way teacher to student instruction) (McCrea and Weaver, 1984). Informal environmental education may include things such as nature study, interpretation, conservation education, outdoor educational activities, field trips to zoos, and nature centers (Knapp et al., 1997; McCrea and Weaver, 1984).

Informal education is seen by many educators as being more effective than formal education because it harnesses a child's natural enthusiasm for

play and exploration, and uses that enthusiasm to educate. Eble (1966) suggested that "everything possible should be done to make the child's zeal for play serve the purpose of formal education." Eble also stated that the perfect educational program is "one that proceeds by surprises and the promise of other surprises, one that offers the most opportunity for discovery" (1966). As Mead (1977) stated, "The artificial world *is* boring . . . boredom is the principal affliction of school children in the United States. . . Think of the most imaginative toy in the world. You know what it can do . . . You take that same child out and watch an ant. Nobody knows what the ant is going to do. The child isn't bored." The mystery of nature, the joy of discovering nature, and the enjoyment of just being in the outdoors are seen by many environmental educators as the most important aspects of environmental education (Carson, 1965; Eble, 1966; Hammerman and Hammerman, 1973; Wilson, 1993, 1994, 1996).

Also, the more senses that are involved in learning, the better that learning will be (McCrea and Weaver, 1984). Interpreters have been using this technique for years, creating 'touch and feel' exhibits, audio visual productions, and even multisensory trails in parks. As Caduto and Bruchac wrote in *Keepers of the Earth* (1989), "Lead children to touch and understand a grasshopper, a rock, a flower, a ray of sunlight, and you begin to establish connections between the children and their surroundings. Have them look at a tree--feel it, smell it, taste its sap. . . . Build on these experiences with activities . . . to develop a conservation ethic."

One environmental education program involving a sensory and conceptual approach was found to significantly increase knowledge and create positive attitudes toward the environment; these measures were found to be stable even a year after participation in the program (Gross, 1977).

Creating real situations for participation involves more brain input, thus giving the student more experiences to remember (McCrea and Weaver, 1984). Watching and doing are more effective than reading and doing, or being told about an experience (Eble, 1966). Real experiences also allow answers to come directly from the students and not from the words of a teacher. The student is involved in discovering the answers, not just accepting and repeating what is told.

Real situations, though beneficial, must be carefully examined by the teacher. Threatening or overpowering situations can hinder learning. For example, a student presented with a problem too difficult to solve (for that age or that individual) will likely be overwhelmed and give up (Bigge, 1964). Teachers should make sure the students are able to succeed, however the experience should also be challenging (McCrea and Weaver, 1984). Evaluation of learning should be in the form of observable behavior changes, not in the form of formal tests, especially when the method of teaching used was informal (McCrea and Weaver, 1984).

Most educators would agree that learning is personal--everyone learns in a different way. Therefore, the programs that are the most diverse in methods should be the most successful. The input children receive does not have to be orderly to be effective--it can be completely random and unplanned. As Hart (1975) stated, "the quantity matters, not the order." Learning is also selective--an individual remembers what he or she wants to remember, so educators should teach information in a way that will be relevant to the learner (McCrea and Weaver, 1984).

Tilden (1957) stated that the introduction of new concepts must relate to previous knowledge or experience, or else learning will be ineffective. This is

not a challenge to most informal educators, as informal methods of teaching are more open to tailoring to different levels, and more open to student involvement than formal education in general (McCrea and Weaver, 1984).

Games

Games, defined by Magney (1989) as "contests between adversaries," have a long history of theoretical benefits. At first, these were listed as mostly psychological (Casbergue and Keiff, 1998). They restored energy and motor functions, and even served as a practice for adulthood (Groos, 1901). More recently, games have been praised by educators as being beneficial to students in three other areas: cognitive, motivational, and attitudinal (Magney, 1989). Erickson (1963) believed play and games could reduce a child's anxiety by giving that child a way to express forbidden impulses. Piaget and Inhelder (1969) stated that children in middle childhood in particular (ages 7-10) especially benefit from play and games because it helps to consolidate prior learning while providing new learning opportunities in a more relaxed atmosphere. The sense of logic that emerges at this age level, Piaget and Inhelder said, enables children to play games with rules, which allows them to develop abilities to work with previously learned skills and establish themselves within a peer-group. This aids social, emotional, and cognitive development. The game is "a window through which students can enter many academic realities. . . and come back with a much fuller knowledge of those realities" (Magney, 1989).

Boocock and Schild (1968) claim that games are also beneficial because they provide a means for students to become active in their own learning. In games, all students participate, not just those who normally dominate academic

settings. Games also help by encouraging student-to-student interactions that are influential on students' performances in instructional settings (Johnson and Johnson, 1980). They become activities that student look forward to, and allow more insecure students the chance to participate in a less threatening situation (Hewitt, 1997). Although games do increase student interest and enthusiasm for learning (as shown consistently in many different studies), they do not demonstrate any improvement in cognitive learning when compared to traditional lecture teaching methods (Magney, 1989).

One study examined an environmental education game designed to increase environmentally responsible behavior. This game was a board game, created for the classroom. Hewitt (1997) created the board game for fourth, fifth, and sixth grade students. She found that students scored significantly better on the environmentally responsible behavior test after playing the game. Indoor or out, games can be beneficial to students.

Review of Program Studies

Many studies have been done on outdoor-based environmental education programs. Hammerman and Hammerman (1973) suggest that an element missing from many programs is the joy of discovery, which can be provided if the classroom is extended outdoors. In the outdoors, they say, students can ". . . enjoy the pure thrill of discovery along with the plain, down-to-earth fun of learning."

George (1967) found that children who participated in activities in conservation clubs and nature camps were more likely to develop conservational attitudes later in life. Asch and Shore (1975) did a study of fifth grade students. Their experimental group, after a two-year hands-on outdoor

education program, demonstrated more conservation behavior than their control group.

It has also been noted that outdoor education programs have other benefits aside from the actual environmental education that occurs. Many studies have also discovered improvements in students' self-concept and socialization. Several studies of students who went to different camps showed pronounced increases in their self-concept after participating in the camps (Becker, 1960; Kriger, 1970; Marks, 1971). Two studies of five-day residential outdoor educational programs showed similar results in self-concept increases (Fletcher, 1973; Nowicki and Barnes, 1970). One study of a twenty-one day Outward Bound program demonstrated no real attitudinal difference in self-concept (Gillette, 1971).

Several studies of sixth graders at residential camping experiences showed improvements in socialization skills (Fletcher, 1973; Kranzer, 1958; Pieroth, 1955), however one study showed no significant improvement (Becker, 1960). Racial acceptance was shown in many studies to be significantly increased after integrated outdoor education experiences (Senior, 1971; Stack, 1960). Acuff (1976) reported racial anxiety to lower significantly among racially mixed campers at a five-day residential camp as compared to non-campers.

A study done by Howie (1972) revealed some interesting findings on a formal environmental education program as compared to an informal, outdoor program. Though he did not test for behavior, he found that when being taught the same basic concepts, the fifth grade students who were formally taught in the classroom scored better on the knowledge test than the students who were taught the same concepts outdoors. He also discovered that there was a slight advantage to students going through both the formal classroom instruction and

the outdoor experience, however this could simply be due to the repetition of information rather that the setting of the instruction. Howie attributed the reason for the failure of the outdoor program to be its unstructured nature. He suggested that a more structured outdoor program might be better than a formal classroom program. Howie noticed in evaluative statements filled out by teachers, staff, and students, that the outdoor experience was seen as positive and beneficial in other ways such as providing enthusiasm for learning, positive attitudes toward school, and positive attitudes toward the environment.

A study done by Kostka in 1976 revealed less successful findings. She examined two environmental educational programs in two nature centers in Minnesota to see if the programs were having a positive effect on environmental attitudes. What she discovered was that the programs were not having a significant effect, that the pupils who scored low on the tests did not like the programs, and these low-scoring groups were reported to be "impervious to improvement" by the naturalists. However, it should be noted that the programs consisted of four to five hours of school activities suggested by the nature centers, and then only a two-hour session at one of the centers. This was not the original design of the programs. The individual exploration sessions, which the nature centers usually provided as part of the programs, was eliminated in order to standardize the research. Naturalists also followed scripts developed for the purposes of standardizing the study, so there was essentially no room for individual exploration at all. Therefore, the programs that were tested in the study were not the real programs the nature centers normally used. It is possible that standardizing the programs for the study modified them in such a way as to make them ineffective.

Conclusion

In conclusion, based on all the research, an effective type of environmental education program should be one that is informal, has some indoor classroom preparation, an outdoor experience which includes some opportunity for individual exploration and discovery, encourages environmentally responsible behavior, and is in the form of a game. The "Riddle of the Woods" program at Oxley Nature Center has all these elements.

CHAPTER III

RESEARCH METHODS AND PROCEDURES

Introduction

The "Riddle of the Woods" program at ONC was chosen for this study because it had all the elements necessary for an excellent environmental education program, according to the research. This study examined this program in detail to discover its effectiveness. If shown to be effective, the program could become a model for a new type of environmental educational curriculum--outdoor mystery games. It should be noted that the researcher gained full approval from Oklahoma State University's Institutional Review Board before conducting this study.

Program Design

The Riddle of the Woods

I come through space without a ship,
Carrying my prize to those who need.

The green ones will capture me, and change me around, but
though they need me, they can't hold me.

Now I am Long-ear and Swimmer and White-tail, through Six-
leg and Singer, toward journey's end.

I am Crawler and Howler and One With No Tail; Sky-screamer
and all release me when they die.

Last to the small ones with no green to show, who will use me,
and end me, and begin again.

Together we build, we breathe, we grow, and if you'll keep us,
we'll keep you, for you see, without us, how could you be?

(found on an old desk, cluttered with notes and magnifying lenses and animal drawings . . .)

The following information about the "Riddle of the Woods" program was based on an interview with the program's creator. The "Riddle of the Woods" program was created by ONC in 1984 to teach the concepts of energy flow and the food chain, which met the environmental curriculum requirements for fourth grade students in Tulsa Public Schools. ONC is located near the Tulsa Zoo in Mohawk Park, a city-operated park. The program was modeled after another program, "The Treasure of the Salt Marsh;" however, no documentation could be found regarding the origins of that program. Although the "Riddle of the Woods" program does not have a mission statement, the mission statement for ONC is "To protect the natural resources placed under our stewardship, to use those resources to provide inviting leisure opportunities to the visitor, and to use those opportunities to provide the highest quality interpretive services which allow the visitors to increase their awareness, appreciation, and knowledge of

our natural and cultural history." Environmental education is not a part of that mission, except for the very last part of the mission statement.

The "Riddle of the Woods" program is extremely popular with science teachers in the Tulsa area. Teachers must reserve a day at ONC for the program at least a year in advance. The program is offered during two seasons of the school year. The fall section runs from late September through mid-November, and the spring section runs from late March through early May. ONC originally allowed only Tulsa Public Schools to participate, but then expanded its capacity to allow private schools, other school districts, and groups (such as scout troops).

The "Riddle of the Woods" program involves three parts. The first part of the program is a visit to the school by one of the nature center's full-time staff, or one of several trained volunteer naturalists (ONC has approximately 40-50 of these volunteer naturalists each year). During this visit, the naturalist presents a slide show with pictures of the nature center, reviewing the types of plants and animals students might see at ONC during their visit. The naturalist also discusses certain vocabulary words with the students such as "herbivores," "wetlands," and other words listed in their Nature Guidebook (see Appendix A). Students are notified that they will be nature detectives, out to solve a mystery for ONC. That mystery is the "Riddle of the Woods", which is printed in the guidebooks. The discussion includes what type of clothing to wear out to ONC on the date of their trip, what to bring for lunch, and other details of that nature. The naturalist leaves a sealed packet with the teacher that is marked TOP SECRET. In this packet are the students' guidebooks. The teacher is given an instructional booklet, which also includes the mystery, has answers to the

activities in the students' guidebooks, and explains the "Riddle of the Woods" program in detail.

Schools from outside the Tulsa area do participate in the program. However, due to financial constraints, ONC cannot provide this site visit to these schools. In these cases, there is no slide show presented, and one guidebook is mailed to the teachers to be copied for all students. Teachers are responsible for the full introduction to the program and the vocabulary.

The second part of the program involves the actual visit to the nature center. Students arrive in the morning and are led to a shelter where a staff naturalist welcomes them to ONC. The naturalist explains some rules (stay behind the guide, stay together, don't litter, don't damage plants, don't remove anything from the woods except trash). The naturalist then reminds the students that they are going to be nature detectives, and that they must help solve the riddle by looking for clues hidden in the woods (these clues are actually lines from the riddle, written on split logs and rocks along ONC's paths). The students are divided into groups of seven to ten. Each group gets its own trained naturalist, and one by one, the groups enter the woods to start looking for clues. Each naturalist is trained to encourage students to point out objects of interest. With seven to ten fourth graders all looking for interesting things such as clues, animal tracks, nests, and strange plants, many different objects can be seen in a small amount of time. The naturalist is also trained to stop whatever he/she is doing when a student points out an object of interest, focus on that object, and ask many questions (ie. What kind of animal made these footprints? Which way was it headed? What foods does it eat? Is it nocturnal? Is it a consumer or a producer?). When clues are discovered, more questions are asked as students still attempt to find the answer to the riddle. It should be

noted that some students solve the riddle before they get to ONC. This is another reason why the students are encouraged to point out objects of interest along the way. It gets all the students involved in the activity, even if they already know the answer to the riddle.

Because each group's experience relies so heavily on what its students discover along the way, each group's experience is different. This is very positive, because when they return to the shelter for lunch, students relate their tales of discovery to their friends. One group may have found and tasted wild plums, another might have seen a snake, and still another might have found a patch of bizarre-looking mushrooms.

After lunch, the staff naturalist begins to solve the riddle with all the students. As the individual students are called on to solve each piece of the riddle, they get a small wallet-sized card stating that they are official nature detectives. Those students whose answer is on a puzzle piece put that piece of the puzzle into place on a large wooden board (a copy of the puzzle is on p. 103 of the teacher's manual, Appendix B). The puzzle eventually reveals the answer to the "Riddle of the Woods", LIFE.

A discussion follows summarizing the riddle, emphasizing how all forms of life and energy are related to each other. The naturalist discusses the harmful effects of removing objects from the woods, littering, not recycling, hurting plants and animals. The reasons why these actions are harmful is always explained from an ecological standpoint, constantly reminding students that all things are related, and to harm one is to harm many. This 'introduction to ecology' is a main goal of the program.

The third part of the "Riddle of the Woods" program is the follow-up portion. This portion of the program is entirely up to the individual teacher.

Follow-up activities are provided for the teacher in the teacher's instructional booklet, and teachers are encouraged by ONC to do some of these with school students after their visit. However, ONC has no control over this section of the program. It is understood by ONC that some teachers do no follow-up activities while others do activities for the remainder of the school year.

Selection of Subjects

For this study, four schools of fourth graders from Tulsa Public Schools were selected. Although ONC now allows some third and fifth graders to participate, this study examined only fourth graders since that was the age group for which the program was designed. Only schools participating in the fall section of the program were considered. The two schools chosen for the treatment schools had teachers who were familiar with the program to avoid any confusion about the progression of the program. These two schools were Grissom Elementary (School 3) and Emerson Elementary (School 4). According to ONC's sign-up process, these teachers signed up for the program a year in advance.

Only schools that did not sign up to participate in the program could be considered as control schools. The two control schools chosen from the Tulsa Public School system were Salk Elementary (School 1) and Patrick Henry Elementary (School 2). They were chosen based on geographic proximity to the treatment groups to help insure demographic similarity.

Research Design

The research design was a Solomon 4-group study with repeated measures (Baumgartner and Strong, 1994). The treatment schools were

divided into treatment groups. Each treatment school had two groups: Treatment Group #1 (TG1) and Treatment Group #2 (TG2). Each control school was divided similarly into two groups: Control Group #1 (CG1) and Control Group #2 (CG2).

The purpose of using a Solomon 4-group design was to insure that the pretest had no effect on the learning experience at ONC. If Treatment Group #1 had scored significantly better than Treatment Group #2 on posttest 1, it would demonstrate that perhaps the pretest itself was a teaching instrument, not necessarily the program. If Control Group #1 had scored significantly better than Control Group #2 on posttest 1, it would demonstrate that Control Group #1 learned from the pretest. In either of these cases, the entire study would be invalid because the testing instrument would have had an effect on learning, and would not be an accurate measure of the effects of the "Riddle of the Woods" program.

TABLE I

TEST DESIGN — SOLOMON 4-GROUP

	Took pretest?	Took posttest 1?	Took posttest 2?
Treatment Group #1	Yes	Yes	Yes
Treatment Group #2	No	Yes	Yes
Control Group #1	Yes	Yes	No
Control Group #2	No	Yes	Yes

There was one testing instrument administered at three different time periods. The pretest was administered to TG1 and CG1 before the scheduled date of the treatment groups' slide show presentations. Posttest #1 was administered to all groups within two days of the treatment groups' visits to ONC. Posttest #2 was a follow-up test given four months after participation in the program to both treatment groups and CG2. Data were analyzed using a

series of one-way ANOVAs and t-tests at the .05 level of significance. The independent variables were treatment and time. The dependent variables were the scores on the test.

Assessment Tool

The instrument used for this study was partially taken from Horvat and Voelker's Environmental Attitude Inventory, *Some Ideas* (1976), and partially created by the researcher and five fourth grade teachers. A copy of the testing instrument used for the study can be found in Appendix C. The test did not change between pretest or posttests, nor did it change between control and treatment groups.

There were three separate subscales on the test. Subscale #1, the knowledge subscale, consisted of numbers 19-27 on the test. These questions were created by the researcher and were evaluated by five fourth grade teachers and a staff naturalist from ONC. Comments that teachers and the naturalist made about the difficulty or relevance of the questions were taken into consideration, and modifications were made until the test met the desired objective (that was, to determine if students came away from the "Riddle of the Woods" program with the environmental knowledge they were intended to, in as few questions as possible). This subscale was not tested for validity or reliability. However, since there was no existing test to measure environmental knowledge about a subject this specific, the researcher accepted the jury's review of this test as sufficient validation.

The test used to measure environmental attitudes and behavior was taken from Horvat and Voelker's Environmental Attitude Inventory, *Some Ideas* (1976). This instrument was designed to measure "environmental

responsibility" of fifth and eighth grade students, their perceptions of environmental problems, and the people who solve these problems. This test was used in the Hewitt study (1997) on fourth, fifth, and sixth grade students, so the researcher felt it would work with fourth graders even though it was not designed for that particular grade level. No other testing instrument for fourth graders could be found that was compatible with the objectives of this study.

The instrument was modified by the researcher and five fourth grade teachers to insure all fourth grade students could understand the questions. One change that was made to all of the *Some Ideas* questions was to modify the traditional Likert-scale responses (strongly disagree to strongly agree) to "yes," "no," and "I don't know." This change was recommended by the teachers so that all fourth grade students could understand what their responses meant.

Some Ideas can be divided up into four interpretable subscales; the researcher chose to use only three of those four in creating the testing instrument for the current study. The *Use/Abuse of Nature* subscale is made up of four questions (numbers 8, 10, 13, and 14 on this testing instrument). The four questions on this subscale related to attitudes about how to treat nature, so these four questions were considered relevant to the study. They formed part of the attitude subscale, Subscale #2, on the current test.

The second subscale from *Some Ideas* that the researcher used was the *General Environmental Concern* subscale, which also consisted of four questions (numbers 4, 11, and 6 on this testing instrument). One question from this subscale was eliminated before being added to the test because the fourth grade teachers felt that students would not understand the question. Another attitude-type question from *Some Ideas* that was not part of a subscale was substituted in its place (number 12 on the current test), but was eventually

removed from the results because it also confused students, according to the teachers. The three questions from Horvat and Voelker's *General Environmental Concerns* subscale that were eventually counted in the results were also included in Subscale #2, the attitude subscale, on the current test. Subscale #2 finally consisted of seven questions.

The test used to measure environmental behavior was taken from the *Eco-responsible Behavior* subscale on the *Some Ideas* test (numbers 9, 7, and 5 on the current test). Since the knowledge subscale had nine questions and the attitude subscale had seven questions, the behavior subscale had to be augmented in order to get a more balanced test. The researcher, along with the assistance of the five fourth grade teachers, created four more questions to increase the amount in this subscale (numbers 15, 16, 17, and 18 on the current test). One of these questions, number 17, was later eliminated from the results because the wording confused students. Subscale #3, behavior, finally consisted of six questions.

Collection of Data

All of the tests were copied and distributed to teachers by the researcher at least two days before the test had to be given. Teachers were instructed to give the test on a certain date (a window of three consecutive days was given each time to adjust for scheduling conflicts). Teachers were given explicit instructions on how to distribute the tests. They were told not to discuss the tests at all, not to help students with answers, and not to mention that the tests were associated with ONC. The researcher understood that teachers may or may not have followed these instructions in the desired fashion, but since some

tests had to be given to two schools at the same time, it was not possible for the researcher to conduct the tests.

The pretests were given the week before the slide show presented by ONC to treatment schools, and control schools took the pretest at the same time. The first posttest was given to all schools and all groups within two days of the ONC visit by treatment schools. The final posttest was given approximately four months after the ONC visit to treatment and control schools. It should be noted that both treatment schools had favorable weather on the dates of their visits to ONC.

TABLE II

SCHEDULE OF TESTING DATES

SCHOOL	PRETEST	DATE OF VISIT	POSTTEST 1	POSTTEST 2
Grissom Elementary School 3 (Treatment School)	10/20/97 (TG #1)	10/30/97	11/03/97 (TG #1&2)	2/24/98 (TG #1) 2/26/98 (TG #2)
Emerson Elementary School 4 (Treatment School)	10/22/97 (TG #1)	11/06/97	11/10/97 (TG #1&2)	2/26/98 (TG #1 &2
Salk Elementary School 1 (Control School)	10/13/97 (CG #1)	N/A	11/04/97 (CG #1&2)	2/26/98 (CG #2)
Patrick Henry Elementary School 2 (Control School)	10/14/97 (CG #1)	NA	10/23/97 (CG #1) 10/22/97 (CG #2)	2/27/98 (CG #2)

Data was coded using a number system. The first possible response in each question was given a '1,' the second was given a '2,' and so on (the only question that did not follow that coding was #2, the age question--for this response, the numerical age of the student was simply entered as that number). This data was entered into a Statistical Package for the Social Sciences (SPSS) computer program (SPSS, 1990).

Using the SPSS program, the data from the three subscales was then recoded to give the most desired responses a value of '1.' Undesired responses, which consisted of all other possible responses in each question besides the most desired one, were given a value of '2.' The most desired responses were determined by the researcher as follows:

TABLE III

DESIRED RESPONSES ON INSTRUMENT

QUESTION NUMBER	DESIRED RESPONSE
4-7	'yes'
8	'no'
9	'yes'
10	'no'
11	'no'
12	eliminated from results
13, 14	'no'
15, 16	'yes'
17	eliminated from results
18	'no'
19	'a tree'
20	'a person'
21	'a frog'
22	'b'
23, 24	'yes'
25	'only plants'
26	'only meat'
27	'omnivores'

Statistical Analysis

The statistical analysis was done on the data using the SPSS program through Oklahoma State University's mainframe computer system. An ANOVA

was performed on each test subscale separately (knowledge, attitude, and behavior) to determine if any statistically significant differences existed within or between groups. Any significant differences found in the ANOVAs were tested using T-tests at the 0.05 probability level to discover where the differences existed.

CHAPTER IV

RESULTS

Hypotheses

The hypotheses to be tested in this study were that there were no differences within or between groups on pretest and posttest scores in the knowledge, attitude, or behavior sections of the test at the 0.05 level of significance. Subjects who did not answer a particular question were eliminated from the results for the subsection in which that question occurred. For example, if a subject left a question on the knowledge subscale blank, that subject's responses were eliminated from the statistical analysis for the knowledge subscale. This is why the number of subjects changes slightly between the knowledge, attitude, and behavior subscale results. Desired scores for each question were given a value of '1,' and undesired responses were given a value of '2.' Therefore, means of lesser value are more desirable than means of greater value. Mean scores that decrease between tests show improvement.

Hypothesis 1--Knowledge Subscale:

The first hypothesis tested was related to environmental knowledge. It stated that there was no difference within or between groups on the knowledge section of the test at the 0.05 level of significance.

TABLE IV

KNOWLEDGE SUBSCALE — ANOVA

Source	D.F.	Sum of squares	Mean squares	F ratio	F prob.
Between groups	2	22.44	11.22	2.95	.0531
Within groups	520	1977.00	3.80		
Total	522	1999.44			

Test cycle	Count	Mean	Standard deviation	Standard error
Pretest	117	12.17	1.89	.18
Posttest 1	225	11.70	1.94	.13
Posttest 2	181	11.65	2.00	.15
TOTAL	523	11.79	1.96	.09

Test cycle	Minimum score	Maximum score
Pretest	9.00	15.00
Posttest 1	9.00	17.00
Posttest 2	9.00	17.00

There were no significant differences within or between groups on the knowledge subscale of the test. The null hypothesis was not rejected. The results of this section demonstrated that there was no significant difference in knowledge between fourth grade students who participated in Oxley's "Riddle of the Woods" program and students who did not participate. It also demonstrated that there was no significant difference within the different groups of students between test cycles. This showed that the students who did participate did not improve their knowledge from the pretest to either posttest.

The students demonstrated a change in their test scores, which although not significant, showed a trend to improve from pretest to posttest #1 and then to posttest #2. Since this particular subscale had 9 questions, the most desired

score would be '9' and the most undesired score would be '18.' No subject scored an '18' on this section, and the mean scores on each test cycle were closer to the desired score of '9' than the undesired score of '18.' Subjects scored higher than expected on the knowledge portion of the test even on the pretest. This meant that subjects had environmental knowledge even before participating in the program. For some unexplained reason, subjects on the pretest scored no worse than a '15,' but scored worse than a '15' on both posttests.

The F probability of the ANOVA was within 0.0031 to the 0.05 level of significance. The researcher considered this to be so close to the 0.05 level of significance that the researcher performed T-tests at the 0.05 level of significance, first comparing the different treatment and control groups to see if any changes occurred between test cycles. In Treatment Group #1, a significant difference was discovered between the pretest and posttest 1.

TABLE V

KNOWLEDGE SUBSCALE — TREATMENT GROUP #1
BETWEEN TEST CYCLES — T-TEST, $p<0.05$

Variable	Number of cases	Mean	Standard deviation	Standard error
Pretest	63	12.32	1.93	.24
Posttest 1	69	11.15	1.83	.22

		Pooled variance estimate		
F value	2-tail prob.	T-value	D.F.	2-tail prob.
1.10	.69	3.58	130	p<.001*

* significant at alpha = 0.05

The probability was significant for these two test cycles within this particular treatment group. This group improved its knowledge scores after participating in the program. The standard deviation and standard error also

decreased, meaning that scores became more alike from the pretest to the posttest. Though this information is interesting, since the ANOVA showed no significant differences, the information gained from this particular T-test is statistically irrelevant.

Hypothesis 2--Attitude Subscale:

The second hypothesis tested was related to environmental attitudes. It stated that there was no difference within or between groups on the attitude section of the test at the 0.05 level of significance.

TABLE VI

ATTITUDE SUBSCALE — ANOVA

Source	D.F.	Sum of squares	Mean squares	F ratio	F prob.
Between groups	2	9.10	4.55	1.87	.16
Within groups	550	1335.10	2.43		
Total	552	1344.20			

Test cycle	Count	Mean	Standard deviation	Standard error
Pretest	126	10.12	1.57	.14
Posttest 1	228	9.89	1.54	.10
Posttest 2	199	10.16	1.57	.11
TOTAL	553	10.04	1.56	.07

Test cycle	Minimum score	Maximum score
Pretest	7.00	14.00
Posttest 1	7.00	14.00
Posttest 2	7.00	14.00

There were no significant differences within or between groups on the attitude subscale. The null hypothesis was not rejected. The mean scores on this subscale slightly improved from the pretest to posttest 1, but then got a little worse from posttest 1 to posttest 2. This demonstrated that students somehow possibly got confused over time regarding their environmental attitudes, the group norms changed, or another unexpected variable occurred. These differences were too slight to make a difference, however. All of the mean scores were closer to the desired score of '7' than the undesired score of '14.' This means that subjects scored higher than average on the attitude subscale, even on the pretest. Subjects already had some positive environmental attitudes before participating in the program.

Hypothesis 3--Behavior Subscale:

The third hypothesis tested was related to environmental behavior. It stated that there was no difference within or between groups on the behavior section of the test at the 0.05 level of significance.

TABLE VII

BEHAVIOR SUBSCALE — ANOVA

Source	D.F.	Sum of squares	Mean squares	F ratio	F prob.
Between groups	2	12.49	6.24	3.42	.0334*
Within groups	555	1012.77	1.83		
Total	557	1025.26			

* significant at alpha = 0.05

Test cycle	Count	Mean	Standard deviation	Standard error
Pretest	124	8.44	1.26	.11
Posttest 1	236	8.23	1.35	.09
Posttest 2	198	8.57	1.41	.10
TOTAL	558	8.39	1.36	.06

Test cycle	Minimum score	Maximum score
Pretest	6.00	11.00
Posttest 1	6.00	12.00
Posttest 2	6.00	12.00

There was a significant difference within or between groups at the 0.05 level of significance. The null hypothesis was rejected. As with the other two subscales, the mean scores were closer to the desired score than the undesired score on each test cycle. This means that subjects had some positive environmental behaviors before participating in the program. As with the attitude subscale, the maximum score on each test cycle increased, or got worse over time. This indicated some confusion on the part of subjects with environmental behavior.

A series of T-tests was performed at the 0.05 level of significance to determine where the significant difference was. The first T-tests were performed to discover if there was a significant difference between cycles; that

is, if any of the treatment or control groups changed significantly between test cycles. Those tests were all insignificant. No significant change occurred between test cycles for any of the treatment or control groups.

T-tests were then performed within the treatment and control groups to see if there were any significant differences within the treatment or control groups themselves. Tests were performed for each of the test cycles: pretest, posttest 1 and posttest 2. There were no significant differences between treatment or control groups on any of the test cycles.

This indicated that the significant difference shown in the ANOVA had to be between the schools. Two significant differences were discovered when comparing school scores on the pretest.

TABLE VIII

BEHAVIOR SUBSCALE — PRETEST SCORES BETWEEN SCHOOLS 2 (CONTROL) AND 4 (TREATMENT) — T-TEST, $p<0.05$

Variable	Number of cases	Mean	Standard deviation	Standard error
School 2	27	8.85	1.20	.23
School 4	32	7.94	1.11	.20

		Pooled variance estimate		
F value	2-tail prob.	T-value	D.F.	2-tail prob.
1.18	.658	3.04	57	.004*

* significant at alpha = 0.05

These results demonstrated that on the pretest, School 4 (a treatment school) scored significantly better than School 2 (a control school) on the behavior subscale. School 4's standard deviation and standard error were less than those for School 2. School 4 had better, and more similar scores than School 2.

TABLE IX

BEHAVIOR SUBSCALE — PRETEST SCORES BETWEEN SCHOOLS 3 (TREATMENT) AND 4 (TREATMENT) — T-TEST, $p<0.05$

Variable	Number of cases	Mean	Standard deviation	Standard error
School 3	36	8.69	1.35	.23
School 4	32	7.94	1.11	.20

		Pooled variance estimate		
F value	2-tail prob.	T-value	D.F.	2-tail prob.
1.49	.264	2.51	66	.014*

* significant at alpha = 0.05

These results demonstrated that on the pretest, School 4 (a treatment school) scored significantly better than School 3 (a treatment school) on the behavior subscale. School 4's standard deviation and standard error were less than those for School 3. This meant that subjects in School 4 were more likely to get a correct answer on the pretest, and their scores were more alike than School 3's scores.

The unexplained reason for School 4's high scores went no further than the pretest. On posttest 1 and 2, there were no significant differences between schools. That means that however different School 4 was from the other schools on the pretest, the difference disappeared for the remainder of the study.

Something interesting did result with School 4's scores on posttest 1, however. School 4's mean on the pretest, 7.9375, is a "better" score than its mean on posttest 1, which was 8.1970. This demonstrated that after participating in the "Riddle of the Woods" program, subjects from School 4 possibly became confused on proper environmental behavior. There is also a

chance that the group norms changed over time, or perhaps some other variable caused this unexpected result.

TABLE X

BEHAVIOR SUBSCALE — POSTTEST 1 SCORES BETWEEN SCHOOLS 2 (CONTROL) AND 4 (TREATMENT) — T-TEST, $p<0.05$

Variable	Number of cases	Mean	Standard deviation	Standard error
School 2	67	8.1343	1.313	.160
School 4	66	8.1970	1.255	.155

		Pooled variance estimate		
F value	2-tail prob.	T-value	D.F.	2-tail prob.
1.09	.718	-.28	131	.779

TABLE XI

BEHAVIOR SUBSCALE — POSTTEST 1 SCORES BETWEEN SCHOOLS 3 (TREATMENT) AND 4 (TREATMENT) — T-TEST, $p<0.05$

Variable	Number of cases	Mean	Standard deviation	Standard error
School 3	53	8.3585	1.545	.212
School 4	66	8.1970	1.255	.155

		Pooled variance estimate		
F value	2-tail prob.	T-value	D.F.	2-tail prob.
1.52	.112	.63	117	.530

Discussion of results

The Solomon 4-group design of the research allowed the researcher to determine if the testing instrument by itself was a learning tool. The ANOVA tests for each subscale demonstrate that there were no significant differences between groups on posttest 1 for any subscale; therefore subjects did not learn

as a result of the pretest alone. The data revealed that on the subscales of knowledge and attitude, there was no significant change between treatment and control groups. The knowledge subscale showed a probability within 0.0031 to the 0.05 level of significance. The follow-up T-test then indicated that Treatment Group #1 learned some environmental knowledge as a result of the program, however this information was statistically irrelevant since the ANOVA test was insignificant.

The behavior subscale ANOVA revealed a significant difference, and the follow up T-tests showed that difference to lie between schools. School 4 (a treatment school) was significantly different than School 2 (a control school) and School 3 (a treatment school) on the pretest. Why did School 4 score so much better than these other schools on the pretest?

The researcher interviewed the teachers from each school after all three tests had been given, and the data had been analyzed. Through the interview process, it became apparent that School 4 did many more environmental behavior activities than the other schools. School 4's students take turns picking up trash on the school grounds. They also do many Earth Day activities, including an Earth Day play. The teacher at School 4 felt that many of the parents of her students were involved in environmental organizations and activities as well. This emphasis on environmental behavior could have been a factor in the high scores on School 4's pretest. However, the fact that School 4's mean score became worse after participating in the program demonstrated that subjects at School 4 might have become confused on proper environmental behavior after the program, the group norm changed over time, or other unexpected variables affected the scores.

The mean scores on each subscale were always closer to the desired score than the undesired score. This indicated that subjects already had some understanding of the knowledge being tested, and some positive environmental attitudes and behaviors. Even though the mean scores did improve, in general, on all three subscales, no significant differences were found between groups. However, since the scores on each subscale were high even on the pretest, it is possible that the improvements could not be significant (they were mathematically too close to the maximum possible limit of score ranges on the pretest to result in a significant difference on the posttests).

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based upon the findings in this study, the "Riddle of the Woods" program at Oxley Nature Center is not effective in changing participants' environmental knowledge, attitudes, or behavior. Although the behavior subscale ANOVA was significant, the significant difference was between schools. School 4, a treatment school, scored significantly higher on the behavior subscale on the pretest than Schools 2 and 3. One possible reason for School 4's high scores is the fact that School 4 does more environmental behavior activities than the other schools. School 4's mean score dropped, however, after participating in the "Riddle of the Woods" program, indicating that subjects became confused about proper environmental behavior after going through the program, the group norm changed over time, or other unanticipated variables affected the scores.

Treatment group #1 did score significantly better on the knowledge subscale on posttest 1 than on the pretest. This significant difference, though encouraging, was not enough for a significant ANOVA probability.
The subjects scored high on all three of the subscales, even on the pretest. This led the researcher to believe that the desired environmental knowledge, attitude, and behavior goals of the program were already present in subjects before participating in the program. In that case, the scores could not improve significantly because they were mathematically too close to the maximum

possible limit of score ranges on the pretest to result in a significant difference on the posttests. The researcher questioned whether this program was age-appropriate. Were the goals too simple for fourth grade students? Why did fourth grade students already demonstrate a firm grasp of the subject matter before participating in the program? Would the program be more appropriate for younger students?

The researcher made observations of other fourth grade students who were not subjects in the study. Observations were made while one group of these students was participating in the program. It was observed that many students knew the answer to the riddle before entering the woods with the naturalist. Knowing the answer to the mystery often takes the fun out of the discovery process, but Oxley designed the "Riddle of the Woods" program so that even students who know the answer still have fun learning with the naturalist. These students were eager to discover objects of interest and point them out to the naturalist and their friends. The naturalists at Oxley are encouraged to let the students point out interesting things and discuss them immediately. This lets all students get involved in the discovery process, even if they have already solved the mystery. This type of teaching method which utilizes the "teachable moment" is highly effective in keeping students interested and maintaining their attention.

Although students are involved and excited about discovering objects of interest, the actual game of finding clues in the woods to solve the mystery is sometimes forgotten during the walk. The researcher observed that on one trip through the woods, the naturalist had to point out the clues to the students, since they were so well-hidden under logs and rocks. This made the process of finding the clues much less exciting for the students. They stopped looking.

Students also were disappointed when they realized that the clues written on the logs and rocks were lines from the riddle that they already knew. The researcher observed students making comments such as, "Well, that was a rip off," "What's the point of those clues?" and "We already knew that."

The researcher also observed that during the end of the walk, students became lethargic and inattentive. The walk seemed to go on too long for a fourth grade student's attention span. The excitement and enthusiasm for discovering objects of interest disappeared as the students began to make comments about being hungry or tired. It is possible that these slight problems with the program hindered the learning process.

The researcher interviewed the four teachers whose students were subjects in the program after all the tests were given. These teachers reported that their students always show enthusiasm about the program, and usually ask to participate in the program again in fifth grade. Teachers also noted that their students sometimes returned to ONC, usually by encouraging their families to go. This is perhaps the most observable benefit of the "Riddle of the Woods" program. The positive effects of the program are spread to those who do not participate, such as family members. Getting people to enjoy being outdoors is part of the process of environmental behavior change. People get attached to the outdoors by enjoying it, and they do not want to see an environment they are attached to be destroyed (Asch and Shore, 1975; Carson, 1965; Eble, 1966; George, 1967; Hammerman and Hammerman, 1973; Wilson, 1993, 1994, 1996).

The teachers also noted that for being mainly volunteer-based, the "Riddle of the Woods" program is extremely well-organized. Teachers felt that the volunteers were always well-trained and reliable. ONC has done an

excellent job designing and executing such a creative educational program on a tight budget. The program is so popular in Tulsa area schools that teachers have to sign up a year in advance. Reservations are on a first-come, first-serve basis, and they fill quickly. If bad weather occurs on the scheduled date of a school's visit, that school is out of luck. There are no make-up dates scheduled at all. This sometimes means that schools show up in bad weather to participate in the program. The researcher wonders if the same educational benefits of the program occur when students must tromp through rain, mud, or freezing cold weather. The lack of make-up dates was one teacher's only complaint about the program.

All of the teachers interviewed felt that the program was appropriate for fourth grade students. According to Tulsa Public Schools' fourth grade science objectives, students at this grade level must learn the basic concept of ecology and ecosystems. This is exactly the subject matter that the "Riddle of the Woods" program was designed to teach. Even though subjects' knowledge did not change significantly after participating in the program, teachers felt that the concepts taught were still appropriate for fourth grade. They noted that these concepts are too abstract and difficult for third graders. The teachers also reported that even if students know the vocabulary words, the program helps them to actually see the different ecosystem components. Being from an urban area such as Tulsa, many of the students do not get a chance to go on nature walks or experience the natural world in a setting such as ONC. This chance for discovery in nature is an important part of the educational process, according to the teachers. Even though the knowledge subscale of the test did not demonstrate any significant changes, teachers argue that the type of connections students make between learning the word 'decomposer' in the

classroom and seeing a mushroom decomposing a rotting log at ONC are an immeasurable yet critical part of a student's environmental education. This researcher agrees.

Perhaps, then, what ONC is teaching is not environmental knowledge, but environmental understanding. The students already know the vocabulary words; that knowledge is reflected in the high mean scores on the knowledge subscale of the pretest. What ONC is teaching, argue the teachers, is the understanding of the vocabulary in a way that cannot be taught inside a classroom or measured on a paper and pencil test.

The "Riddle of the Woods" program also encourages students to think about nature in ways they might never have before. Teachers love the way ONC naturalists let students discover a hole in a tree, for example, and then ask students to consider why the hole is there, what might live there, and what would happen if a person threw trash into the hole. This process, teachers argue, is teaching environmental knowledge, understanding, attitudes, and behavior all at the same time.

Teachers felt that the attitude portion of the test used in this study was not specific enough to the "Riddle of the Woods" program to be an accurate measure of changes in subjects' attitudes toward nature. Fourth graders are not abstract enough to apply attitudes about specific things they learned at ONC to other aspects of their lives. The test itself may have been a poor measure of the environmental knowledge, attitudes, and behavior learned at ONC. Although this particular study found that the "Riddle of the Woods" program did not change fourth grade students' environmental knowledge, attitudes or behaviors, it is still a wonderfully creative program that sparks student interest in nature, and it should be studied in more detail.

Recommendations

The researcher recommends ONC make some slight modifications to its "Riddle of the Woods" program. First of all, ONC should write a mission statement for the program itself. The mission statement for ONC seems too general to be a mission for the "Riddle of the Woods" program ("To protect the natural resources placed under our stewardship, to use those resources to provide inviting leisure opportunities to the visitor, and to use those opportunities to provide the highest quality interpretive services which allow the visitor to increase their awareness, appreciation, and knowledge of our natural and cultural history"). Environmental education is not a part of that mission, except for the very last part of the statement. The researcher believes the specific goals of the "Riddle of the Woods" program are to teach fourth grade students the importance and role of each link of the food chain, how our behavior can damage the environment, and the vocabulary words related to basic ecology. ONC's goals for the "Riddle of the Woods" program are vague to the visitor, because they are not written into a mission statement. If a mission statement for this particular program can be developed, a testing instrument that is specific to the program can be designed to determine if students are reaching the specific goals.

Another recommendation is for students to be given a break during the walk. A fifteen minute break, taken at a point at which the naturalist feels appropriate, would decrease students' lethargy and inattentiveness at the end of the walk. This break could also be a snack break, where leave no trace principles would be taught and practiced. This would also help students make it until the scheduled lunch time. Students are not accustomed to the amount of walking that occurs during the hike, and even though they are encouraged to

eat a big breakfast, many of the students would benefit from a snack that they brought from home.

A third recommendation for the program is to make the clues hidden throughout the woods easier for the students to find so that the naturalist does not have to find them for the students. This would get the students more involved in the mystery game.

The clues themselves could also be changed to make the game more interesting. From the researcher's observations it was apparent that students did not like the fact that the clues hidden in the woods were parts of the riddle they already knew. The point of hunting for clues seemed to have no purpose, since students already knew what all the clues said. Perhaps clues could be additional pieces to the puzzle, different from the pieces written into the riddle.

The teachers who were interviewed liked the program the way it was. They were impressed by the amount of learning that takes place in such a short amount of time. However, one teacher complained about the fact that ONC had no make-up days in case of bad weather or problems with transportation. ONC has no make-up days because it tries to schedule as many schools as it can into the time periods available. Teachers realize that make-up days would be extremely difficult to schedule, but they would be greatly appreciated.

Another suggestion for a change to the program was made by one teacher who felt the program might be improved by making it a two-day visit instead of one. This teacher stated that there is so much to explore at ONC, students do not get a chance to see all the different ecological communities present at the site. With the short amount of time a school has at ONC, there is not enough time to fully explore the communities they do get to see. To combat this problem, the teacher suggested that the program could be lengthened into

a two-day visit (perhaps a visit in fall and another in spring, or a visit of two consecutive days). The first day would be devoted to solving the riddle, with the program proceeding the same way it already does. The second day would involve the students studying and observing two or three different communities in detail. These studies would be brought back to the classroom in the form of projects, graphs, lists of plants and animals observed, research papers or other types of follow-up activities. The teacher felt that ONC needs to expand its program by adding more volunteers and allowing more schools to participate.

Call for Future Research

The "Riddle of the Woods" program needs to be investigated in more detail. There are many possibilities for the implementation of a program such as this in other nature centers and park settings. The program is inexpensive, easy to design (once the riddle has been written), and will most likely be popular with local teachers in any area.

Some more research needs to be done on this program, however, in order to answer questions this study did not. Since randomness was limited in this study in the choosing of four schools, the four particular schools chosen could have had some impact on the results. A random selection of subjects should be studied, using the same methods, to determine if that was a factor.

It is also possible that the test itself was a factor. As stated in Chapter 2, the evaluation of learning should be in the form of observable behavior changes, not in the form of formal tests, especially when the method of teaching used was informal (McCrea and Weaver, 1984). Perhaps it is not possible, then, to give a paper and pencil test that accurately measures student learning in an informal educational program such as this one. If another reliable, valid

test for environmental knowledge, attitudes, and behavior designed for fourth grade students can be obtained or created, the same study should be repeated with that new instrument. If not, a study should be done using observations of environmental behavior as the testing instrument.

Many of the attitude and behavior subscale questions on this test were not specifically related to the "Riddle of the Woods" program. The program could also be teaching environmental understanding, rather than environmental knowledge. This instrument was not designed to test environmental understanding, although the researcher questions whether any instrument can effectively measure environmental understanding. If one can be designed, this would be an excellent follow-up study.

The researcher is aware of the fact that much student success can be related to a teacher, or in this case, to the particular naturalist taking the students on the walk at ONC. It is possible that students having one naturalist learn quite a bit while students having another naturalist do not learn much at all. A study could be designed to compare individual naturalists by testing the students who are guided by them.

Is weather a factor in the educational experience? The groups tested in this study had fair weather on the dates of their visits. The researcher questions if the same amount of learning occurs if students are uncomfortable due to weather conditions such as rain, mud, cold, heat, or other environmental conditions such as numerous mosquitoes. A study should be done comparing the learning that occurs in good weather compared to unpleasant weather. ONC takes students through the woods, even in rain and cold if the teachers want to go. This is because there are no make-up dates scheduled, so teachers are willing to endure bad weather for the educational experience they

feel is so valuable to their students. However, if no learning takes place because students are uncomfortable, then taking students through the program in bad weather might be a waste of time.

In conclusion, even though this particular study found the "Riddle of the Woods" program to be ineffective in changing fourth grade students' environmental knowledge, attitudes, and behavior, the program is still worth further investigation. It gets students excited about being outdoors. It brings other people to the nature center as students want their families to see what they saw on the trails. It allows students to discover the wonders of nature. The test used in this study, the non-random selection of subjects, or the particular naturalists that led the program may have had effects on the results of the study that the researcher could not perceive.

The basic formula of the "Riddle of the Woods" program is easy to replicate, and can be implemented to teach about the structures of different ecological communities. The riddle might have to be modified or rewritten, but the design of the program itself is adaptable. It can also be implemented not only in nature centers and parks, but also in botanical gardens, zoos, outdoor classrooms, or simply on school property. Children love mysteries, games and scavenger hunts. If educators can take these elements, as ONC has done, and use them to get children to learn about and love the outdoor environment, then positive environmental behavior likely will follow.

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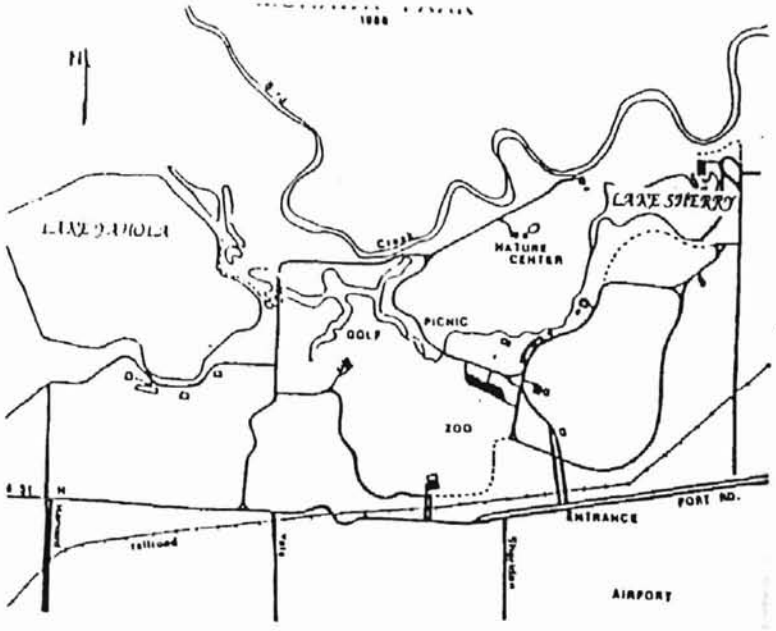
APPENDICES

APPENDIX A:

OXLEY NATURE CENTER

NATURE DETECTIVE'S HANDBOOK



Official

Oxley Nature Center
Nature Detective's Handbook

This handbook belongs to:

_____

Date of fieldtrip to Oxley Nature Center:

_____

Tulsa Park and Recreation Department

Oxley Nature Center

Table of Contents

The Riddle of the Woods

I come through space without a ship,
Carrying my prize to those who need.

The green ones will capture me, and change me around, but though they need me, they can't hold me.

Now I am Long-ear and Swimmer and White-tail, through Six-leg and Singer, toward journey's end.

I am Crawler and Howler and One With No Tail; Sky-screamer and all release me when they die.

Last to the small ones with no green to show, who will use me, and end me, and begin again.

Together we build, we breathe, we grow, and if you'll keep us, we'll keep you, for you see, without us, how could you be?

(found on an old desk, cluttered with notes and magnifying lenses and animal drawings ...

Introduction to this Handbook

This handbook is for you. It is a fun way to get ready for your fieldtrip to Oxley Nature Center. You won't have to memorize these things for a test, and you won't be graded on it. The more you read it and study it, though, the more fun your trip will be, because it will help you become a Nature Detective.

Work on the puzzles, think about the mysterious Riddle of the Woods, practice looking for tracks and other nature clues at school & at home, and soon you'll be ready. If you need help with anything, ask your teacher or a librarian or your folks. Or, you can save your questions for the day of your fieldtrip: you might find the answers at the Nature Center!

There are ideas for things to do after the fieldtrip, too. Once you become a Nature Detective, you can be one for the rest of your life, if you want. It's a great hobby, and there are always new and exciting things to discover!

It's time to begin...

Three Places to Explore

You will visit these three places at Oxley Nature Center!

A NTRL CMMNTY OF LARGE AND SMALL PRDCRS, AND THE CNSMRS AND DCMPSRS WHICH USE THIS AREA TO FIND FOOD & SHELTER.

Place:_____

A NATURAL COMMUNITY WHICH IS COVERED WITH WATER AT LEAST PART OF THE TIME, AND WHERE VARIOUS AQUATIC PLANTS AND ANIMAL LIVE.

Place:_____

A LARUTAN YTINUMMOC MADE UP OF LLAMS STNALP, SUCH AS SESSARG AND SBURHS, AND THE SLAMINA WHICH USE THIS AREA FOR DOOF AND RETLEHS.

Place:_____

bullfrog tracks

Three Special Words

Break the codes to discover the meanings of three special words.

1-14-9-13-1-12-19 23-8-9-3-8 7-5-20

20-8-5-9-18 5-14-5-18-7-25 2-25 5-1-20-

9-14-7 16-12-1-14-20-19 15-18 15-20-8-

5-18 1-14-9-13-1-12-19.

Answer:_____

MAKE M ◆  OWN 

FROM THE N ◆ R ◆ G OF THE 

Answer:_____

12-9-20-26-13-18-8-14-8 4-19-18-24-19

25-9-22-26-16 23-12-4-13 7-19-22

24-22-15-15-8 12-21 23-22-26-23

11-15-26-13-7-8 26-13-23 26-13-18-

14-26-15-8, 7-6-9-13-18-13-20 7-19-22-14
25-26-24-15 18-13-7-12 8-12-18-15.

Answer:_____

Key Words

Try to find all the Key Words in this patch of letters. (A good Nature Detective should know what all of the Key Words mean.)

community

ecology

environment

environmental awareness

soil, air, water, sunlight

forest, field, wetlands

carnivore, herbivore, omnivore

predator, prey

producer, consumer, decomposer

(These Key Words might help you with some of the other puzzles in your handbook!)

Key Word Find

E C O L O G Y R E T A W S S
N N A W P R E D A T O R U S
V A V N L A R C O W D E N O
I X W I T I P O S E U C L M
R Y F A R R O N U T B U I E
O T L H R O G S M L D D G R
N I Y C F E N U A A E O H O
M N X D G I N M C N R R T V
E U F O U R N E E D S P T I
N M I O F M A R S N A K U N
T M E F O R E S T S T E R R
R O L O M N I V O R E A T A
E C D E C O M P O S E R L C
E F L O W E R O V I B R E H

You may find some other words in this puzzle, too. Look for:

flower
redbud
sumac
turtle
fly

cow
tree
moss
fox
owl

ant
den
nut

...and there may be others.

Definitions

(These will help you solve the puzzles & codes.)

Carnivore- an animal which eats (or consumes) other animals for energy (meat eater).

Community- a group of plants & animals living together in the same area. What community do you live in?

Consumer- animals which get their energy by eating plants or other animals. Are you a consumer?

Decomposer- organisms (like bacteria, mushrooms, or termites) which get energy by breaking down the cells of dead plants or animals, turning them back into soil (soil maker).

Ecology- the study of the dependence of plants & animals on one another, and their dependence on the environment.

Environment- the world around you, your surroundings:
a) Urban Environment (city)- surroundings which people change for themselves.
b) Natural Environment (wild place)- surroundings relatively unchanged by people.

Environmental Awareness- an understanding and appreciation of the natural and urban environments. This is what you will develop for yourself after you solve the mystery of the Riddle of the Woods.

Field- a natural community made up of small sun-loving plants, such as grasses & shrubs, and the animals which depend on this area for food & shelter.

Food Chain- the order of what eats what.

Forest- a natural community made up of large trees and smaller, shade-loving plants and the animals which depend on this area for food & shelter.

Herbivore- an animal which eats (or consumes) plants for energy (plant eater).

Omnivore- an animal which eats (or consumes) both plants and animas for energy. What are you?

Predator- an animal that hunts & kills other animals for food.

Prey- an animal which is hunted & killed for food by a predator.

Producer- living things which make (or produce) their own food using soil, air, water, and energy from sunlight (green plants).

Wetlands- a natural community which is covered with water at least part of the year, and where various aquatic plants and animals live (stream, creek, river, pond, lake, marsh, swamp).

Four Needs for Life: Soil, Air, Water, Sunlight

NATURE CLUES

Every Nature Detective learns to look for clues, because most wild animals are not active during the day, and are also very shy and seldom seen. Plants can also provide many clues about the past, as well as about the animals of an area. Here are some things to be aware of:

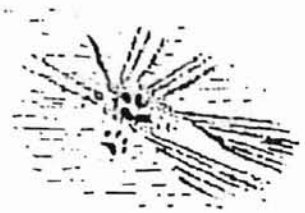
Mashed or broken plants- was this an animal's bed last night, did an animal eat here, or is it a trail? If it's a trail, where does it go, and why?

Nibbled nuts or berries or fruits or mushrooms or stems- how big were the animal's teeth? How long ago was it here? Where did the food come from?

Bones- what kind of animal did they belong to? How did it die? How long ago did it die?

Holes in the ground- who dug this hole and why? How deep does it go? (note: although snakes like to live in holes, but they cannot dig a hole for themselves; they have to find one to live in.)

Droppings (also called Scat)- lots of information here! How big was the animal, compared to a dog? How long ago was it here? What had it been eating, and is it a healthy animal? What else can you find?

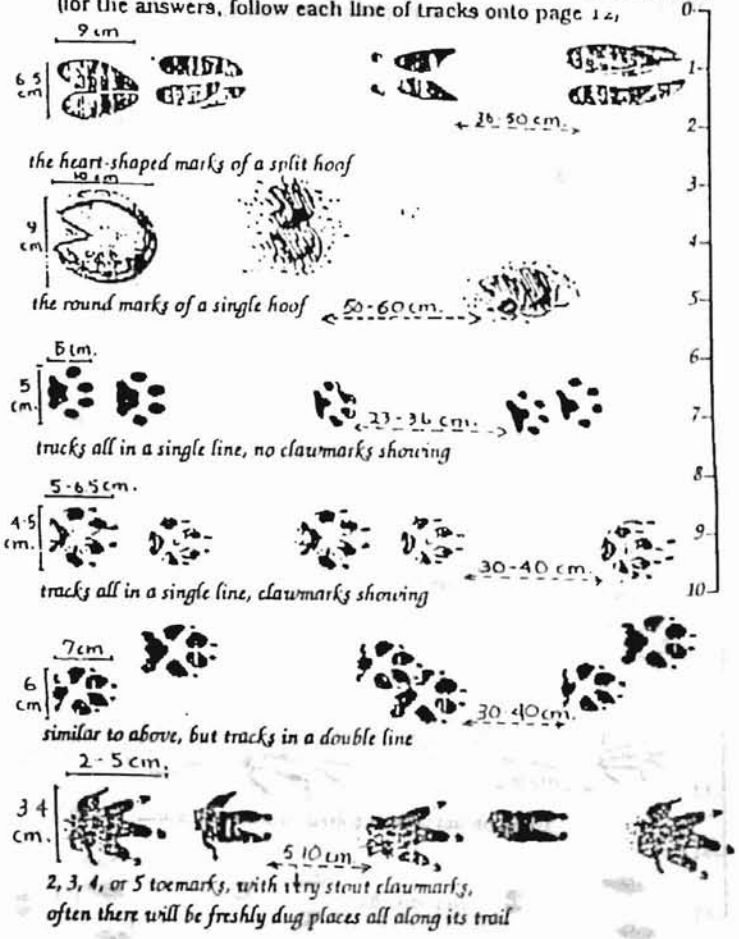


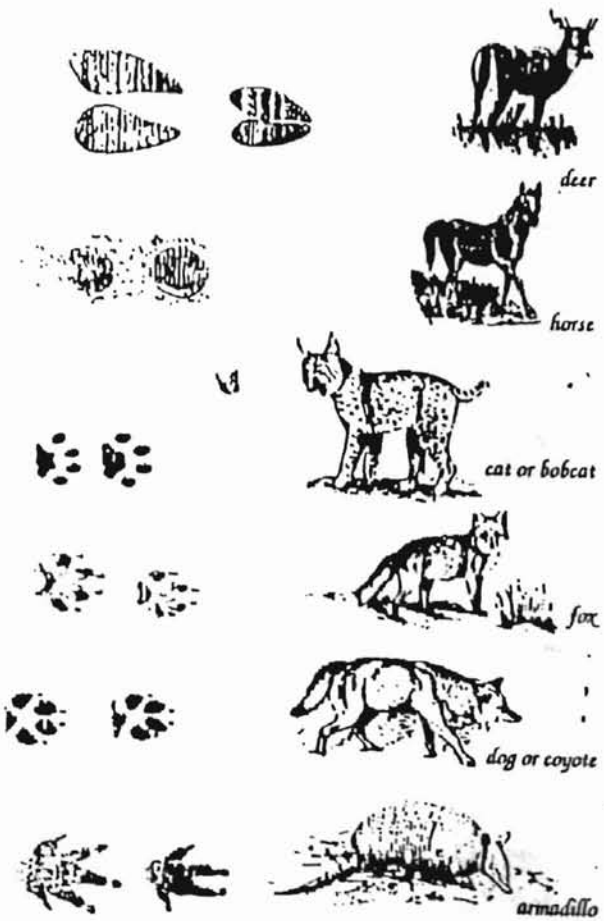
Bobcat scat

ANIMAL TRACKS

Scale (in centimeters)

(for the answers, follow each line of tracks onto page 12)

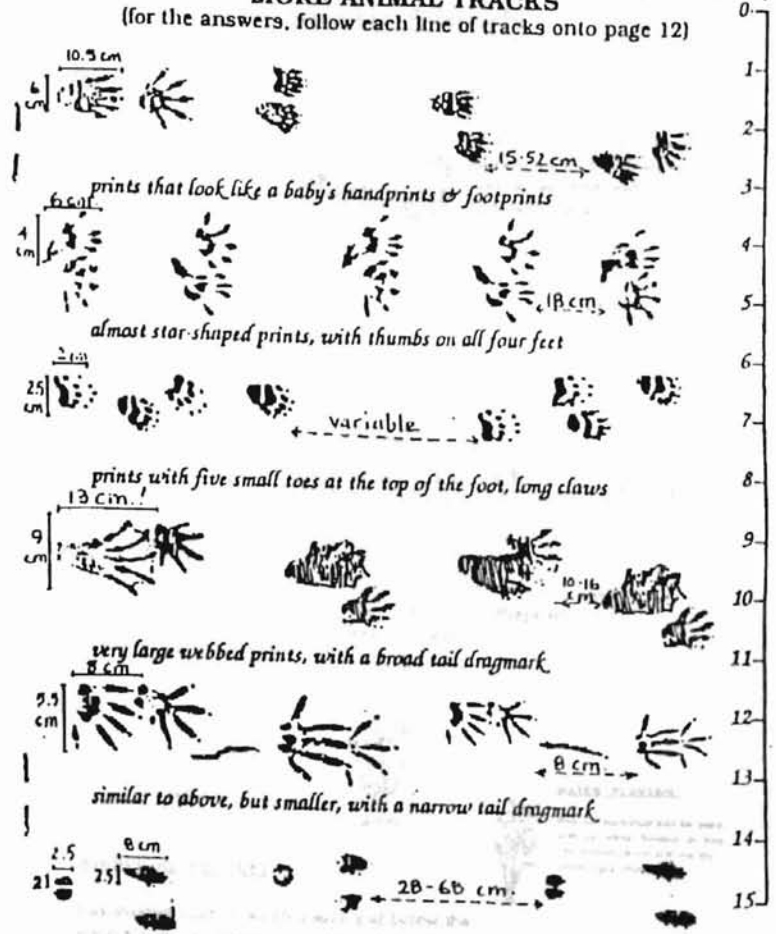


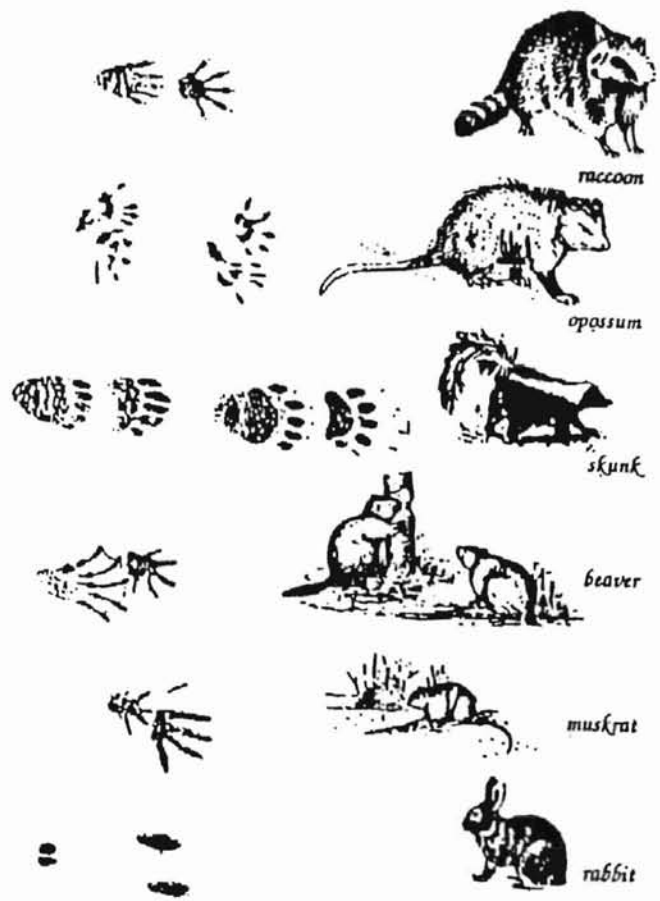


MORE ANIMAL TRACKS

(for the answers, follow each line of tracks onto page 12)

Scale (in centimeters)





Aquatic Animals

WATER SNAKE:

This non-poisonous snake is often confused with the cottonmouth. It is usually seen sunning on logs or branches over water. The body is dark with various cross patterns.

WATER SPIDER:

Also called the Fish Spider, this predator is equipped with a large number of body hairs that help to distribute its weight on the water surface. The hairs also trap air, giving it a silvery appearance. Preys upon insects.

WATER STRIDER:

This pond skater has waxy hairs on the legs that are arranged to repel water and keep the insect afloat. Preys on small insects.

larva

adult

WHIRLIGIG BEETLE:

Has divided eyes to watch above and below the water's surface. Takes in a bubble of air at abdomen to breathe underwater. Eats insects found on surface film. Larvae are cannibalistic and prey upon bloodworms and insect nymphs by injecting poison into prey before eating.

WATER PLANTAIN:

MOSQUITO:

In order to breathe underwater (for up to 10 minutes at a time), larva project a respiratory tube and hang by hydrophobic hairs. They feed on algae and microorganisms. Recognized by the wiggling motion as they swim downwards. Only the adult females suck blood from their prey.

MAYFLY:

Recognized by gills on sides of abdomen, long, leathery, forked tail, (usually 3 forked), and legs with a single claw. Eats microscopic plant forms (diatoms). Adults do not eat and only live about one day to mate and lay eggs.

DRAGONFLY:

Voracious carnivores, these feed on insects and tadpoles. Swim by pulsating water out of the abdomen. Adults feed on insects caught in flight. Wings are held horizontally when at rest.

DAMSELFLY:

The small relative of the dragonfly, identified by 3 plate-like gills on tail. Preys on insects. They hold their wings parallel to their bodies at rest, and are slender. The dragonfly and damselfly belong to the oldest order of insects, Odonata (300 million years old).

WATER DOCK:

The brown cluster of the branch bases resembles the upright rock plant. The leaves are active and flat in many on the margins. The seeds can be ground into a flour.

FLOATING PRIMROSE WILLOW:

Recognized by the yellow 5 petal flowers and alternate leaves. The creeping/floating stems can be up to 10 feet long.

WATER FLEA

These tiny animals have their bodies compressed side to side, and a hinged, elongated second antennae to aid in swimming. Feed on detritus. They are important food for fish, insects, and wading birds.

DIVING BEETLE

Large, predaceous beetles that are long lived (about 5 years). They carry an air bubble at the tip of their abdomen for underwater respiration.

WATER SCORPION:

This brown, stick like insect lurks in the mud or vegetation waiting to capture passing insects. Two long filaments at the abdomen interlock to form a respiratory tube for air intake at surface film.

BLOODWORM:

This small, red "worm" feeds on algae and detritus. The adults look like small mosquitoes but do not bite.

CRAYFISH:

An omnivorous predator that is usually active at night. When alarmed will dart quickly backwards. Stones can be found with mud piled up on one side of opening. Sheds outside skeleton as size increases. Large claws in front aid in capturing prey.

DUCKWEED

The tiny floating plant often forms a green blanket on the water surface. It reproduces by budding or bloom. A favorite food of ducks, muskrats and beavers.

FROGS AND TOADS.

Tadpoles are the immature or larval stage of frogs and toads. They long, compressed tail is used for swimming. Spring is the best time for hearing the croaking of various frogs and toads. Two common ones are: a. Chorus frogs - sound like the noise made by running a fingernail along the teeth of a comb. b. Leopard frogs - sound like a low chuckle.

SNAILS:

Snails feed on algae and detritus. Gill snails seldom reside in polluted water, while lung snails can tolerate it. Tentacles are touch receptors. Eggs are found attached to objects in a clear, spherical jelly mass.

WATER BOATMAN:

Identified by oar like arms that propel them through the water. Minute hairs on the ventral side capture air, creating a silver sheen called an air plastron. They feed on plant material.

WATER MITE:

A small, bright red arachnid that is parasitic on insects and worms.

FISH:

There are five common types:

a. Gar - a large fish with a long "beak" armed with sharp teeth. Feeds on other fish captured by sudden dashes. Have a lung like sac with blood vessels that supplements oxygen intake when the supply is low (usually both are).

b. Carp - this relative of the goldfish has a single dorsal fin. Plows up the bottom when feeding on small plants and animals. This often causes heavy siltation from which many plants and eggs of other fish die.

c. Catfish - scaleless fish with long barbels around their large mouths. Scavenges on the bottom and can live in low-oxygenated, muddy waters.

d. Bluegill - a small fish with 6-8 vertical dark-colored bars on the sides. This sunfish is often found in aquatic weeds feeding on insects.

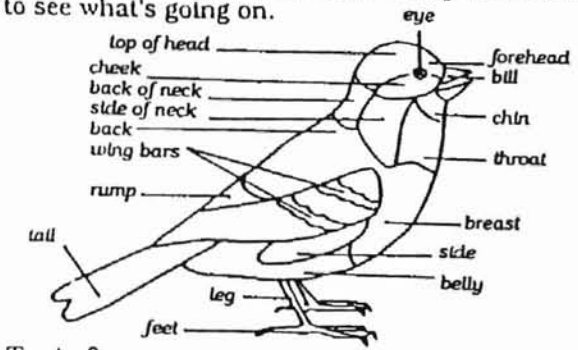
e. Mosquito Fish - a small fish (1-4cm) that resembles a guppy. Lives near the top of the water and feeds on insect larvae.

CATTAIL

A very tall plant on the edges of water. Has spike topped stems 2-4 feet at the leaves. Often used by red winged blackbirds to nest in. A versatile edible plant. Everything from the roots to the pollen can be prepared for eating.

LOOKING AT & LISTENING TO BIRDS

It takes practice to be able to spot birds, but once you've trained your eyes to see them and your ears to hear them, they are a good clue to what's going on around you. For instance, are the blue jays giving their alarm call? Maybe people are approaching. Or, are a lot of different birds fussing and screeching? Maybe a snake is after a nest of eggs or a fledgling. Can you hear crows talking to each other? Stand very still and make "pshl pshl" noises. Many birds will think it's a young bird calling for help and will fly close to see what's going on.



Try to figure out what the bird's doing: is it eating, bathing, escaping, calling for a mate, announcing its territory...? Does the bird have any unusual colors or markings? What kind of beak and feet does it have? Is it bigger or smaller than a robin?

Note: Nature Detectives know that the best parents for baby birds are adult birds. If you find a fallen nestling that has feathers but can't fly, just leave it alone. It's probably a "brancher," a baby too big for the nest but too young to fly. The parents will follow it around & care for it. If it is blind & helpless, ask an adult to help you put it back in its nest, using gloves to protect you from disease. Another nest will do, if you can't reach or find

FIELDTRIP DAY

My checklist of things to do and bring:

O Bring permission slip.
O Wear comfortable old clothes that can get wet or muddy.
O Wear a hat, long thick socks, long pants, and layers of short-sleeves & long sleeves.
O Eat a huge breakfast.
O Bring a lunch (w/no glass containers in it.)
O Put your name on your lunch sack.
O Leave your valuable possesions & money at home.

The weather was _____

My naturalist's name was _____

My favorite thing was _____

_____

_____

The most exciting part was _____

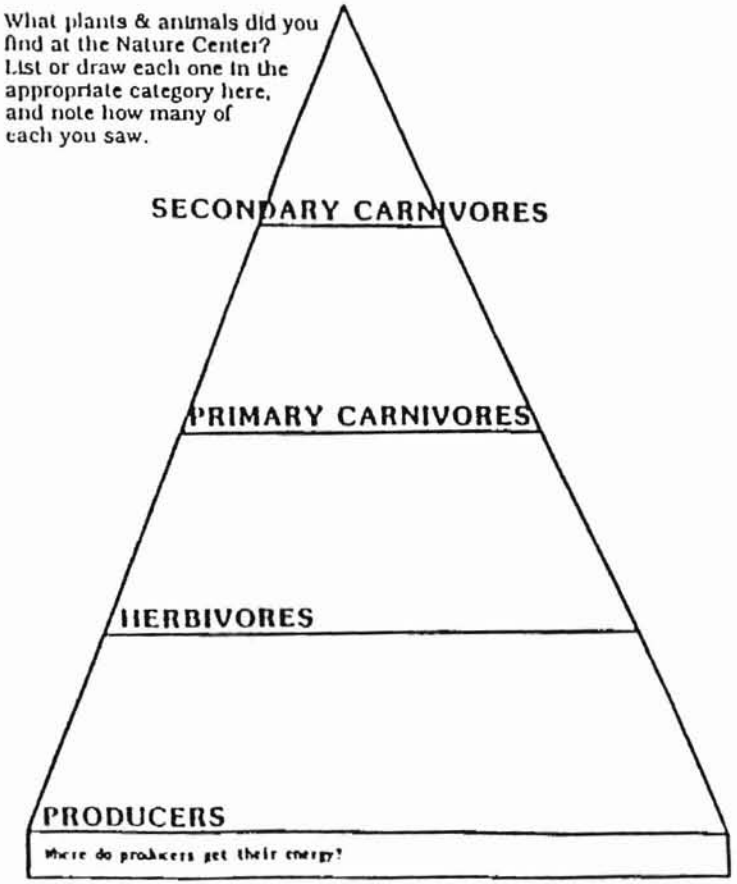
_____

_____

tape or
fasten your
Nature Detective
card here

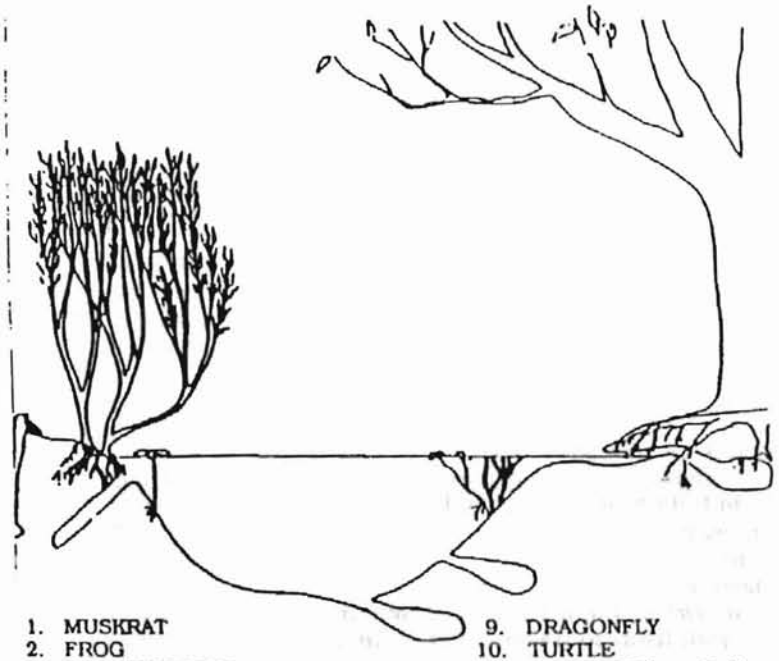
Pyramid of Life

What plants & animals did you find at the Nature Center? List or draw each one in the appropriate category here, and note how many of each you saw.



Why do you suppose there are more producers (green plants) than primary consumers (also called herbivores?) Or more primary consumers than secondary consumers (also called carnivores, or omnivores?)

Wetlands



1. MUSKRAT
2. FROG
3. INSECT NYMPHS
4. KINGFISHER
5. DIVING BEETLE
6. WATER STRIDER
7. SNAIL
8. MOSQUITO
9. DRAGONFLY
10. TURTLE
11. CRAYFISH (crawdad)
12. MINNOW
13. RACCOON
14. HERON
15. TADPOLE
16. LEECH

Each of these creatures is found in or around water.
Each has a favorite place to be.
Draw each creature in its usual location, or put its number there.
Put a star beside every creature you have seen in real life.
Draw lines between animals that eat each other.

MORE THINGS TO DO AT HOME

Now that you are an official Nature Detective, you can have fun with your new skills.

☐ Explore your own neighborhood, looking for tracks and animal homes, and listening for insects and birds.

☐ Make a feeding station for birds and squirrels. If you can't buy bird seed, try giving them bread crusts and acorns and kitchen scraps (remember, if it's not really very healthy for you to eat, like potato chips and candy, it's probably not very healthy for your wild friends, either.) You may end up with a raccoon or opossum or field mice visiting your feeding station, too! Your feeding station should be protected from neighborhood cats and dogs, if possible. If there are trees and bushes to hide in nearby, your visitors will be safer and will be more likely to come to your feeding station. It may take them several weeks to find your feeding station and start using it.

Window Tray

Poured Cement in a Pile of Arranged Stones

☐ Make a plaster-of-paris cast of an animal track (you may need to check out a book from the library to show you how to do this, or ask an adult for help.)

☐ Start a Nature Detective's Journal or Scrapbook. Keep all your drawings and sketches in a Notebook. Make sure you have a place to write down your discoveries and observations.

☐ Pick out a special tree or small plot of land near your home, and watch it through the seasons. Take pictures or make sketches for each season.

☐ Visit other nature trails and parks and museums. Use your Nature Detective skills to compare how some things are the same (like producers and consumers and decomposers,) while other things may be very different (maybe there is a rocky creek or a sandy beach or a steep wooded cliff to explore.)

☐ Make a terrarium or an aquarium. If you have animals in either place, make sure they have enough room to be happy and healthy, and the right kind of food and water (spiders must drink out of a sponge or dampened sand, for instance,) and the right amount of light and darkness. In fact, it would probably be best if you turned the animals loose after a day or two, instead of keeping them "in jail" forever, or until they die.

☐ Note: be very careful around wild animals of any kind. Some animals can sting; nearly all can bite or scratch, and some could make you pretty sick.

GOOD BOOKS

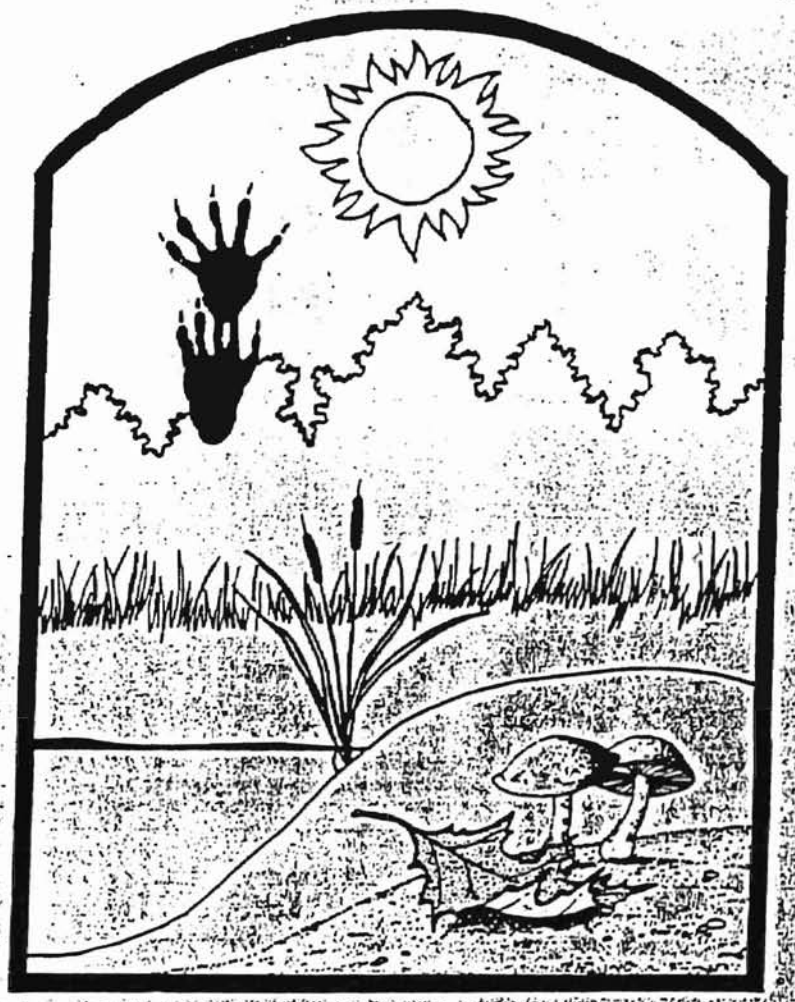
Adams, Richard Nature Day & Night & other books
Allison, Linda The Reasons For Seasons
Blaustein, E. & R. Investigating Ecology
Brett, Jan Annie & the Wild Animals
Burns, Marilyn I Am Not a Short Adult!
Caney, Steven Kid's America
Carson, Rachel A Sense of Wonder and other books
Chinery, Michael Enjoying Nature With Your Family
Cornell, Joseph Sharing Nature With Children
Docekal, Eileen Nature Detective. How to Solve Outdoor Mysteries *(Eileen used to work at Oxley Nature Center!)*
Dr. Seuss The Lorax
Eckert, Allan W. Incident at Hawk's Hill
Env. Action Coalition It's Your Environment
George, Jean C. My Side of the Mountain & others
Goble, Paul The Gift of the Sacred Dog and others
James, Bessie R. The Happy Animals of Ata-ga-hi
Jobb, Jamie The Night Sky Book
Kipling, Rudyard Just So Stories and other books
Mitchell, Andrew The Young Naturalist
Morrison, Gordon The Curious Naturalist
Palmer, William R. Why the North Star Stands Still
Palmer & Fowler Fieldbook of Natural History
Parnall, Peter Everybody Needs a Rock & others
Pettit, Ted S. A Guide to Nature Projects
Schwartz, C. & E. Wild Mammals of Missouri
Selsam, Millicent How to be a Nature Detective
Seton, Ernest T. Wild Animals I Have Known
Sisson, Edith A. Nature With Children of All Ages
Stokes, D. & L. Nature Guide series
Teale, Edwin W. Autumn Across America & others
Wigginton, Eliot The Foxfire Books
Wilder, Laura Ingalls The "Little House" series and others...

NOTES

APPENDIX B:

SEARCHING FOR THE "Riddle of the Woods"

TEACHER'S GUIDE



Searching For the Riddle of the Woods

An Environmental Education Program for Fourth-Grade Students Visiting Oxley Nature Center

SEARCHING FOR THE RIDDLE OF THE WOODS

A Fourth-Grade Level
Environmental Education Program

Developed By the Staff of Oxley Nature Center
1984

Preparatory and On-Site Activities Developed By
Byron Ball, Senior Staff Naturalist

The Riddle of the Woods Written By
Robert Jennings, Director

Follow-up Activities By
Donna (Hamilton) Horton, Staff Naturalist

Revised By Donna Horton, Senior Staff Naturalist
1991

Student Handbook Developed and Edited By
Donna Horton, Senior Staff Naturalist
1991

Oxley Nature Center
5701 East 36th Street North
Tulsa, Oklahoma 74115
(918) 669-6644

printed Summer 1995

The Riddle of the Woods

I come through space without a ship,
Carrying my prize to those who need.

The green ones will capture me, and change me
around, But though they need me, they can't hold me.

Now I am Long-ear, and Swimmer, and White-tail,
Through Sixleg & Singer, toward journey's end.

I am Crawler, and Howler, and One With No Tail,
Sky-Screamer & all, release me when they die.

Last to the small ones, with no green to show,
Who will use me, and end me, and begin again.

Together we build, we breathe, we grow,
and if you'll keep us, we'll keep you, for you see,

Without us, how could you be?

TABLE OF CONTENTS

Introduction

The purpose of this program is to introduce students to the world of nature. Each part of the program has been carefully developed to ensure a quality experience for your students as they explore the natural environment of Oxley Nature Center.

There are three basic parts to the program:

1) **Before the Fieldtrip**, which is designed to prepare both you and your students, building excitement, setting goals, and developing an understanding about what the visit to the Nature Center will be like.

2) **The On-Site Program**, which will be presented by the professional staff and trained volunteer naturalists at Oxley Nature Center.

3) **After the Fieldtrip**, which is a series of in-class and at-home follow-up activities designed to help your students to build upon and reinforce the new ideas they have discovered at the Nature Center.

Program Goals

"All living things, including ourselves, are dependent on other living things for LIFE. This interdependence is fueled by the energy of the sun."

That sums up "the Big Picture," the overall concept of what we're trying to convey to the students. Students should leave the Nature Center understanding that:

1) life on earth is made possible by the energy of the sun,

2) all living things, including people, are dependent on other living things for survival, and

3) people have a greater capacity to affect the way the environment works and so have a responsibility to maintain the balance of nature.

BEFORE THE FIELDTRIP

School Volunteer/Chaperone Training

The Nature Center recommends, but does not require, that your school provide volunteers to accompany the students on the day of their fieldtrip. A ratio of one adult for every 7 to 10 students will match the Nature Center's recruitment goals, and should result in one school volunteer chaperone available to assist with each trail group.

The Nature Center will provide a three-hour orientation and training session for school volunteer chaperones at the beginning of each season, in September and again in March. **This training is very strongly recommended for all school volunteer chaperones.** In fact, the Nature Center staff would rather have *no* school volunteers than untrained school volunteers.

An information/recruitment flyer will be sent to all Tulsa Public Schools from the Education Service Center at the beginning of the school year. All other schools using this program may request a flyer from Oxley Nature Center, if one has not already been included with this teachers' manual.

Teacher Orientation

A one-hour orientation session for teachers is scheduled at the beginning of each season, in September and again in March. The session is held after school at Oxley Nature Center, which gives you a chance to find the place and look it over before the day of your fieldtrip. It provides an opportunity to confirm dates and times, to outline the details of fieldtrip preparation and responsibilities, and to clear up any questions on your part. No hiking is involved. Call the Nature Center (669-6644) to find out the date and time, if you have not already been notified.

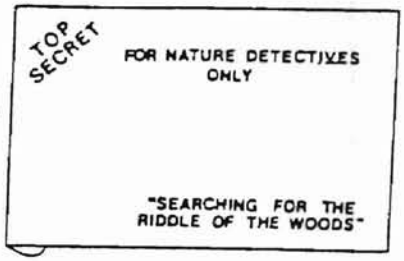
This training is very strongly recommended for all teachers new to the Riddle of the Woods program.

In-Class Visit

All Tulsa schools scheduled to Search For the Riddle of the Woods will have a visit from an Oxley naturalist about a week before their fieldtrips. The naturalist will present a thirty-minute slide program that introduces vocabulary and basic concepts and also helps the student develop some expectations about the fieldtrip. Details of what to wear, what to bring are discussed, and if time permits, some questions will be answered. The naturalist will also deliver a packet of student handbooks.

☐ **Check to see when your In-Class Visit is scheduled.**
If you have any problems with the date and/or time, please notify the Nature Center (669-6644) with at least two days notice in order to re-schedule the visit.

All schools scheduled for the Riddle of the Woods *which are located outside the Tulsa city limits* will receive their packets of student handbooks and fieldtrip confirmations through the mail. In-Class Visits are not available for schools outside of Tulsa because of time and budget restrictions.



To Begin

The whole purpose of writing this program as a mystery is to build excitement and suspense, to pique your students' interest and curiosity, and to allow them to develop their own skills of observation and deduction. It should be fun!

☐ **Plan to spend a short amount of time (15-45 minutes) each day for a week or so before the fieldtrip,** discussing and working on the student handbooks and the Riddle of the Woods. Don't solve the Riddle before you get to the Nature Center; speculate and wonder and come up with possibilities and questions to test and answer on the day of the fieldtrip.

Arrange to have someone special, maybe the principal, deliver the packet of student handbooks to the classroom. Make a dramatic moment of Opening The Packet. Read the Letter from the Nature Center to the class.

☐ ***Activity One: Read the Letter.***

Letter From the Nature Center

Hello Nature Detectives,

Here at Oxley Nature Center, we are in the business of solving riddles. The people who work here are called naturalists, and it is our job to investigate the beautiful and sometimes mysterious happenings in the world of nature. You will be visiting us soon, and we hope you will help us solve the mysterious "Riddle of the Woods."

Not long ago, one of the naturalists found this Riddle, lying on an old desk, cluttered with nature notes, magnifying lenses, and animal drawings. It was written by an old nature detective. This old explorer of the woods lived among and with the wild creatures and plants of the forest, fields, and wetlands. By watching the plants and animals grow and live, the old nature detective began to understand how everything in nature works together, and that we humans are also part of the workings of nature.

During your visit to the Nature Center, we will need to study nature like the old nature detective did, if we are to solve the Riddle. We will need to use all of our senses and be aware of all that is happening around us. We will be finding clues to the Riddle left behind by the old nature detective and by the plants and animals of the Nature Center.

Before your visit, you will need to practice your nature detective skills. In your handbooks you will find some fun and helpful activities for you to do. They will help you prepare for a great day of riddle-searching to come. Carefully listen to your teacher's instructions, and get ready for your fieldtrip!

With good preparation, and by using all of our senses when we explore the Nature Center together, we should be able to solve the Riddle and find out what it means. Good luck for now, and we'll see you soon!

Reading the Riddle

Now read to the class, or have a student read aloud, the mysterious "Riddle of the Woods." Pass it around the class, and then post it in a special place, preferably near a table or in an area designated as a temporary "nature center." Later on, this is where natural objects brought in by students, such as nuts, shells, feathers, stones, and other things, can be displayed and looked at and handled.

☐ *Activity Two: Read the Riddle and post it.*

The Student Handbooks

The student handbooks are designed to prepare the students for their fieldtrip with vocabulary and basic nature study skills. The activities should not be presented in such a way that the students feel that they will be tested on them or that they must memorize them. The reward will come later, when they are able to use these words and skills during the fieldtrip. The students should work on these activities at their own pace, but you should plan a little time each day to review a small section or a particular activity.

☐ *Activity Three: Pass out the Student Handbooks and go over the Introduction together.*
(You may also want to introduce the first activity now: Three Places to Explore.)

Three Places To Explore

There are many different kinds of plants and animals that live at Oxley Nature Center, because there are many different kinds of places for them to live. Here are clues to the three types of habitats, or places to live, that you will explore during your fieldtrip. (The Definitions might be a good place to look for help with these puzzles.)

☐ *Activity Four: Solve and discuss Page 4 of the Student Handbook, "Three Places to Explore."*

5

Three Places to Explore
(Teacher's Answer Sheet)

A NTRL CMMNTY OF LARGE AND SMALL PRDCRS, AND THE CNSMRS AND DCMPSRS WHICH USE THIS AREA TO FIND FOOD & SHELTER.

To break the Code: put in the missing vowels.
Answer: "A natural community of large and small producers and the consumers and decomposers which use this area to find food and shelter."

Place: Forest, or Woodlands

Follow-up Questions: What kinds of forests are there? What types grow in Oklahoma? How are they alike or different?

A NATURAL COMMUNITY WHICH IS COVERED WITH WATER AT LEAST PART OF THE TIME, AND WHERE VARIOUS AQUATIC PLANTS AND ANIMALS LIVE.

To break the Code: hold the page up to a mirror.
Answer: "A natural community which is covered with water at least part of the time, and where various aquatic plants and animals live."

Place: Wetlands

Follow-up Questions: How many kinds of wetlands can be found in the Tulsa area? How are they alike or different?

A LARUTAN YTINUMMOC MADE UP OF LLAMS STNALP, SUCH AS SESSARG AND SDURHS, AND THE SLAMINA WHICH USE THIS AREA FOR DOOF AND RETLEHS.

To break the Code: rewrite the odd-looking words; they're spelled backwards.
Answer: "A natural community made up of small plants, such as grasses and shrubs, and the animals which use this area for food and shelter."

Place: Field, or Grasslands

Follow-up Questions: What kinds of animals prefer to live in the grasslands? Why don't they live in forests or wetlands?

6

Three Special Words
(Teacher's Answer Sheet)

1-14-9-13-1-12-19 23-8-9-3-8 7-5-20

20-8-5-9-18 5-14-5-18-7-25 2-25 5-1-20-

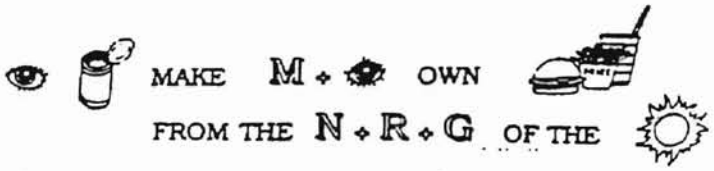
9-14-7 16-12-1-14-20-19 15-18 15-20-8-

5-18 1-14-9-13-1-12-19.

To break the Code: 1 = A, 2 = B, 3 = C, ... 24 = X, 25 = Y, 26 = Z.
Answer: "Animals which get their energy by eating plants or other animals."

Answer: Consumers

Follow-up Questions: What are some consumers that live in your neighborhood? Which ones eat plants? Which eat meat?



In a rebus code, the combination of words, letters, and pictures illustrates the sounds of the syllables.
Answer: "I can make my own food from the energy of the sun."

Answer: Producers

Follow-up Questions: What kinds of plants live where you do? Do they make anything besides food?

12-9-20-26-13-18-8-14-8 4-19-18-24-19 25-9-22-26-16 23-12-4-13

7-19-22 24-22-15-15-8 12-21 23-22-26-23 11-15-23-

26-13-23 26-13-18-14-26-15-8. 7-6-9-13-18-13-20

7-19-22-14 25-26-24-15 18-13-7-12 8-12-18-15.

To break the Code: 1 = Z, 2 = X, 3 = Y, ... 24 = C, 25 = B, 26 = A.
Answer: "Organisms which break down the cells of dead plants and animals, turning them back into soil."

Answer: Decomposers

Follow-up Questions: Has anyone ever seen or smelled decomposers? What did they look or smell like? What were they decomposing? How long did it take to turn into soil?

7

Three Special Words

Every living thing has a job to do, and needs energy to live and to do that job. Here are clues to the three kinds of living things, and the three ways of getting energy, that you will find during your fieldtrip. (The Definitions might be a good place to look for help with these puzzles.)

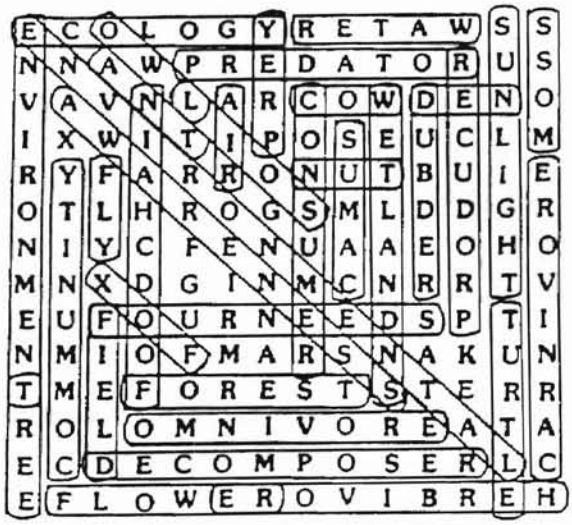
❑ *Activity Five: Solve and discuss Page 5 of the Student Handbook, "Three Special Words."*

Key Word Find

The Key Word Find is a fun way to begin to get familiar with words that may be used during your fieldtrip. (Once again, the Definitions might be a good place to look for help with these puzzles.) Remember, the students should not be tested over or forced to learn this vocabulary.

❑ *Activity Six: Solve and discuss Pages 6 & 7 of the Student Handbook, "Key Word Find."*

Key Word Find
(Teacher's Answer Sheet)



Nature Clues

The students should be getting a pretty good idea by now of what it means to be a Nature Detective. Almost everyone has picked up a smooth rock, wondering how it got so smooth and round. Or a feather, trying to imagine what bird it came from or admiring the color and shape and feel of it. Or a claw from a crayfish (or crawdad,) working the hinge back and forth, and trying the sharpness of the points against a finger. All of those are the actions of a Nature Detective, curious and ready to find out about the natural world.

You can make it possible to bring that natural inquisitiveness and willingness to learn into the classroom by setting up an area where the students may display and handle natural objects, such as shells, stones, bits of fur, etc., that they have brought from home. Before you set up your "Touch-It Table," you should think about and discuss very carefully with the students the idea of bringing or displaying or handling live animals. In general, it is not a good idea. In certain circumstances, keeping an aquarium or a terrarium with live animals can be very educational, but you should make the safety of your students and the welfare of the captive animal a top priority. You might do some reading on the subject first.

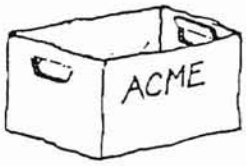
☐ ***Activity Seven:*** ***Set up a "Touch-It Table" near the posted copy of the Riddle. Look over page 10 of the Student Handbook together.***

Special Task List For Students

A day or two before the fieldtrip, have one student do each task and report back to the class.

❑ **Call the Nature Center (669-6644) between 10:00 am and 4:30 pm. Identify self as a student reporter from _____ School, and ask about any interesting or unusual animal or plant activity occurring at the Nature Center. Be prepared to write down 3 or 4 items.**

❑ **Call the Weather Service Forecast Recording (838-3375) for a weather forecast for the day of your visit. Report back to the class and discuss what to wear.**



❑ **Cut a handle on each side of several sturdy boxes, to carry the lunches and drinks from the bus to the shelter.**

❑ **Make sure everyone has a name label to put on their lunches and drinks.**

❑ **Make sure everyone has a nametag with the first name printed neatly and clearly.**

Checklist For Teachers

❑ **Send a letter home to parents,** informing them of the upcoming fieldtrip and the need for a sack lunch.

❑ **Discuss allergies to bee or wasp stings, and poison ivy prevention** (see Clothing and Shoes & Socks, below.)

If any students have severe allergies and/or medical problems that may require medication to be carried and administered on the trail, you may want to have the school nurse or the parent of that child accompany the group on the day of the fieldtrip. Call the Nature Center and advise the staff: there's a chance that a guide with training or familiarity with a particular health problem may be available.

(You and your students may be relieved to know that no venomous snakes have ever been found at the Nature Center.)

❑ **Breakfasts and Lunches!**

___ Remember not to bring glass containers.

___ Discourage lunch pails and "carry-homes."

___ Remind everyone to put their names on their lunches and drinks. Are the names legible and waterproof?

___ Have a pre-fieldtrip discussion about proper food for lunches: some students seem to get little supervision from home, and end up making a meal of chips, candy, and pop.

___ **Remind them of the importance of eating a good breakfast the morning of the fieldtrip.**

❑ **Clothing.**

___ Remind the students to wear appropriate clothing for being outside most of the day. The morning may be chilly, and the afternoon may be hot. Recommend layers of short-sleeve shirt, long-sleeve shirt, and a jacket or coat if necessary. Hats are a very good idea.

___ Legs should be protected by long pants; girls who must wear dresses or skirts should choose long ones and should wear long socks to protect exposed skin from weed scratches, insect bites, and/or poison ivy. Shorts are not appropriate.

Wear clothes that can get muddy and/or wet.

❑ **Shoes and Socks.**

___ Wear things that can get muddy and/or wet.

___ Wear shoes and socks that will protect legs and feet from weed scratches, insect bites, and/or poison ivy.

___ Wear shoes and socks that you can walk in comfortably for more than one mile.

New or borrowed shoes can cause blisters.

❑ **Raingear.**

___ Bring a roll of large plastic trash bags, just in case.

___ If it looks like the students may get rained on at the Nature Center, make sure they each have a towel, and a dry change of shoes, socks, underwear, and outer clothing waiting for them back at school.

❑ **Nametags.**

___ First names should be printed largely and clearly.

___ Nametags should be fastened on securely.

THE ON-SITE PROGRAM
(the fieldtrip)

Basic Schedule

___ am	Departure from your school.
9:30 am	Arrival at Oxley Nature Center.
9:45 am	Morning discovery hike begins.
12:00 noon	Return to Picnic Shelter for lunch.
12:30 pm	Solve the Riddle.
12:50 pm	Afternoon discovery hike begins.
1:30 pm	Departure from Oxley Nature Center.
___ pm	Arrival back at your school.

How It Works

Plan your departure so that the students arrive at Oxley Nature Center around 9:30 am. As you enter the gates of the Nature Center, be on the lookout for wildlife, and for signs directing your school to one of the two parking areas. Most Riddle of the Woods tours will be directed to the Picnic Shelter parking area at the far end of the entrance road, through a gate with a "Road Closed" sign attached to it. After the bus arrives, that gate will be pulled shut, but not locked.

At the Picnic Shelter parking lot, one of the naturalists will board the bus to welcome your group, and to give some preliminary instructions. With lunches and all personal belongings in hand, the class then departs for the Picnic Shelter, the "home base" of the day.

At the Shelter, the lunches are stowed in a cool, shady closet, and the class is seated on the concrete floor to review the schedule and the basic safety rules. This is a good time to team up (quietly) any chaperones and school staff with Nature Center guides, preferably one-on-one. School volunteers, especially untrained volunteers, should not be allowed to cluster into one group. This presorting also helps allow parents to go in groups other than with their own children. Parents may go with their own children if they

wish, but it is not usually recommended. (This is not a good time to apply insect repellent or cause other distractions, while the students are listening to and discussing the safety rules.) Everyone is advised to use all of their senses and to search for any clues left behind by the old nature detective or by the plants and animals that live at the Nature Center.

Now the naturalist divides the students into small trail groups of 7 to 10 students and assigns each group to a guide. Oxley staff are getting pretty good at identifying and separating possibly troublesome combinations of students, but will be glad of discreet advice from the people who know these students best. Advise the naturalist, if you didn't do so before you left the school, of any medical problems, such as asthma, diabetes, allergies, etc., that may arise on the trail; some of the guides have training or familiarity with certain medical conditions and would be especially suited to lead a particular group. If any students require medicine to be carried or administered during the hike, the teacher, or the school nurse, or the parent of that child, should accompany that group.

The discoveries begin! As the trail groups explore the forest, fields, and wetlands, a variety of basic ecological concepts are discussed, very much more informally than in a classroom, but with no less effectiveness.

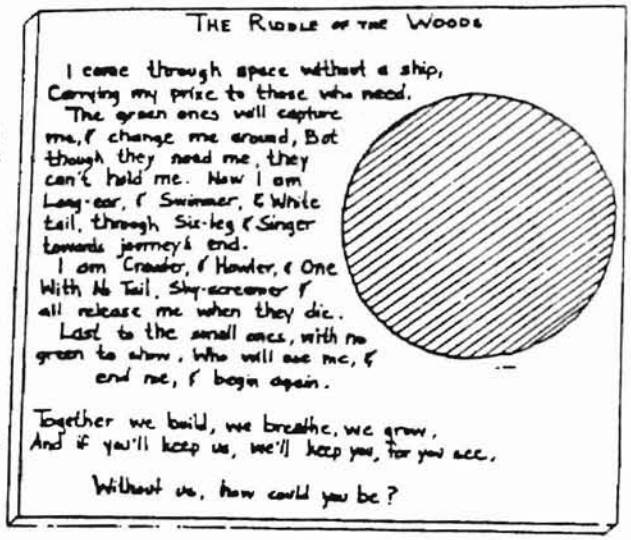
Besides the lessons illustrated by the plants and animals that live at the Nature Center, the students may also find, at special locations along the trails, clues left by the old nature detective. On the undersides of certain strategically placed rocks and slabs of wood, an appropriate piece of the Riddle of the Woods is carved or written. For example, the part that mentions "the small ones with no green to show" will probably be found near a rotting log or a good place to find decomposers. When a clue is located, the group will stop and talk about what that part of the Riddle might mean, and who or what the old nature detective was talking about in that part of the Riddle. Emphasis is still not placed on solving the whole Riddle, just on thinking about part of it and coming up with ideas on what it could mean.

By lunchtime, the students will have found one or more Riddle clues, and by adding this information to their other nature discoveries, may be getting some ideas about what the different parts of the Riddle may mean.

All groups meet back at the Shelter at noon for lunch. With the class again seated on the concrete floor, lunch rules are explained, and the lunches are distributed.

Solving the Riddle

After lunch, the students are gathered in front of a large puzzle board, where the Riddle is printed in its entirety. Beside the Riddle is a circular hole where the puzzle pieces are placed. There are 15 puzzle pieces, each with the name of an individual element in the Riddle (e.g. sun, plants, rabbit, coyote, decomposer, etc.)

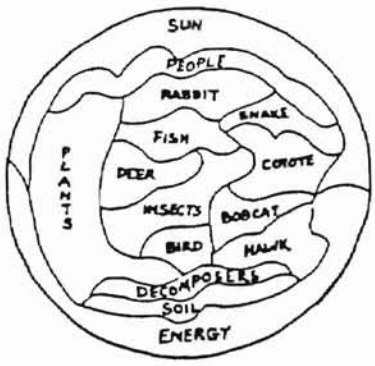


As the naturalist and students discuss the meaning of the Riddle, each segment is reworded, using Key Words and terms or ideas discovered on the trails. The class discussion may go something like this:

"Okay, the first part of the Riddle says that 'I come through space without a ship, carrying my prize to those who need.' How many of you figured this part out? What was the old nature detective talking about here? Asteroids? Yes, they come through space; do they carry a prize? Aliens? Who found aliens today? Anyway, aliens probably need a ship. Air? There is no air in outer space. Stars? Yes! What is the nearest star, and the only star you could see today? The sun! There's a puzzle piece here that says "SUN;" come up and put it in. Does it carry a prize? ENERGY! Very good; come up and put this puzzle piece in! Now, who needs energy..."

As each segment of the Riddle is discussed, the students who answer the questions correctly are awarded their official Nature Detective cards. If the answer involves one of the puzzle pieces, that student is invited to come up and place the piece in the panel. In this way, the students are able to see how the different parts of the Riddle fit together and interact with each other. Soon the entire puzzle is together, and a single word becomes visible to the class.

The five different colors of the puzzle spell out the word LIFE. The conclusion is reached, and the Riddle itself explains how life is composed of many different pieces, all working together. Without all the parts of the puzzle, life as we know it would be changed, and might not even be possible. The old nature detective was telling us that all living things, including people, depend on each other, and on energy from the sun, for survival.



Any student who did not receive a Nature Detective card during the discussion gets one now. The trail groups reform for a short afternoon period of hikes and/or nature games.

At 1:30 pm, the class boards the bus, and returns to school.

That's the end of the fieldtrip, but only the beginning for a lot more discoveries and lessons...

AFTER THE FIELDTRIP

Making Connections

The foundations are now in place for an incredible variety of lessons. You can refer back to the trip to Oxley Nature Center again and again, and tap into that exciting memory to reinforce the lessons of the classroom. Also, you can use the discipline and rules we use at Oxley to try some outdoor lessons at your school. Once students learn that the outdoors is not just a place for recess, it becomes easier to use the outside world for your classroom.

It's important to realize that "nature" can be found everywhere, not just in a nature center. Have your students try out their nature detective skills around the school or at home. The urban environment has many similarities to the natural environment, as well as some differences. By drawing comparisons, a pattern will begin to emerge. Read the Riddle again; it still holds true in the city. Maybe the plants and animals are different, and the urban forest may not look quite like the wild forest, but predators still hunt their prey, and herbivores and carnivores still depend on producers to harness the energy of the sun.

We hope that the suggestions here spark some new ideas of your own. And maybe you were able to get some new insights regarding your students, by seeing them in a different environment (a classroom is a difficult place for some students to shine.) At the very least, we hope that some connections have been made, between your students and the world around them, between your classroom and the real world, and between you and your students.

Pyramid of Life

Did you ever wonder why, in any given community, there are so many millions of individual plants (grass, for example,) so many thousands of herbivores (grasshoppers, for example,) so many hundreds of carnivores that eat herbivores (small birds and grass snakes and turtles, for example,) and only a dozen or so carnivores that eat other carnivores (like cats and hawks?) The answer is, a million blades of grass will not feed a million grasshoppers, because each grasshopper eats more than one blade of grass. Also, some energy is lost or wasted each time something eats something else, like when the grasshopper jumps to the next blade of grass.

All this is pretty abstract for fourth-graders. A concrete way to demonstrate this concept is to make a human Pyramid of Life.

In a large area, such as a grassy yard, or a gym with mats, assemble your students in groups of ten or so. Start by naming each group to represent a particular habitat: forest, field, pond, school grounds, river, a nearby park, etc. Each student in a group chooses a plant or animal from that particular habitat. It's all right if two or more choose the same plant or animal, especially if two or more of those items were actually observed. Now, have them form a human pyramid.

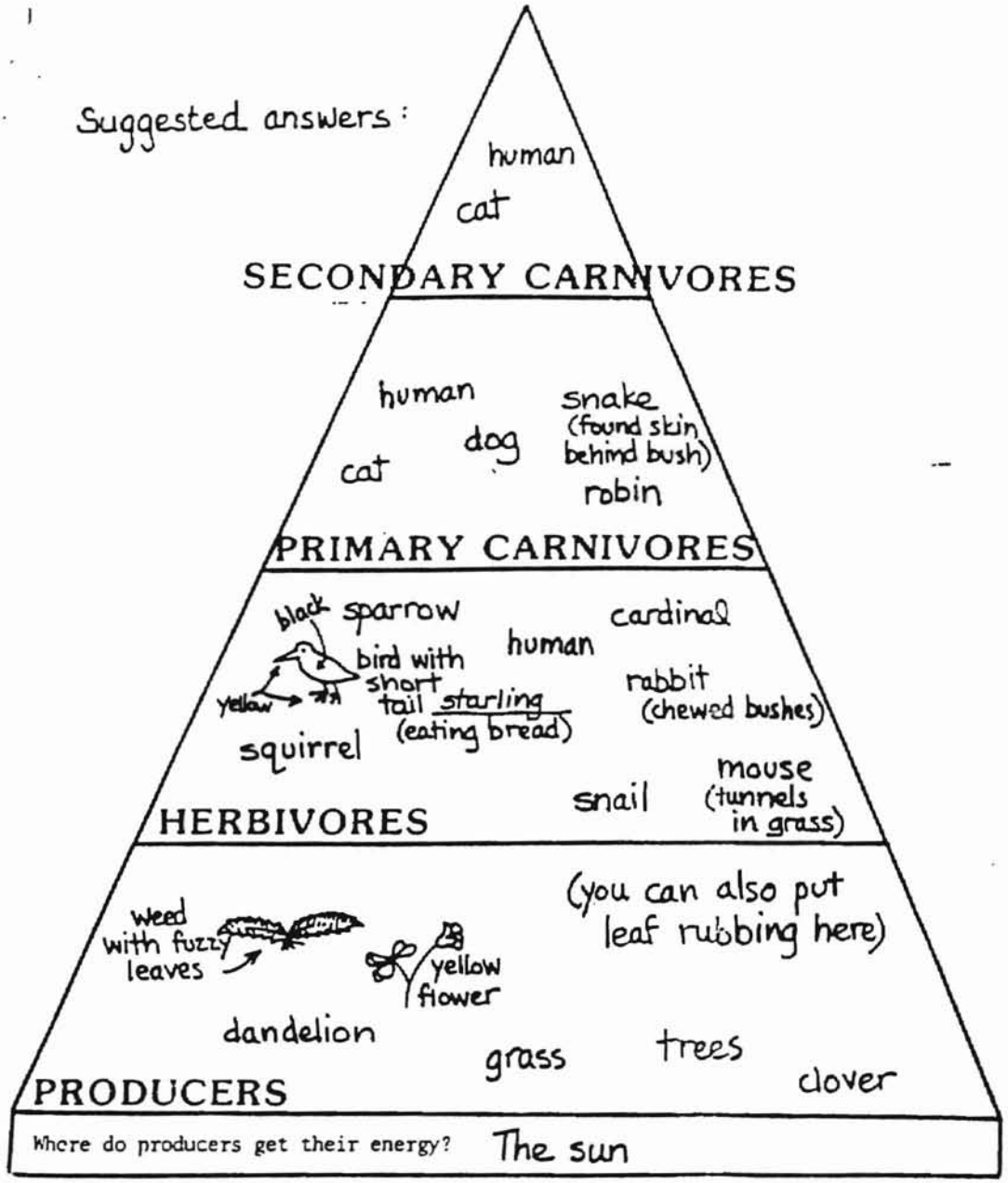
Put the producers on the bottom, side-by-side in a row, on hands and knees. The next row will be people representing herbivores, each with hands resting on the adjacent shoulders and knees on the adjacent hips of two producers. The third row is the group of animals that eat herbivores (primary carnivores,) while on top will be perched the secondary carnivores, the animals which eat other carnivores.

It will soon become obvious that you've got to have lots of plants (preferably big strong students,) fewer herbivores, and even fewer carnivores (preferably the smallest, lightest students.) Now make a successful Pyramid. When you get the proportions close to what they are in real life, your Pyramid will work. Catalog all the plants and animals you discover, by using the Pyramid of Life page in the Student Handbook.

☐ ***Activity Eight:*** ***Make a human Pyramid of Life. Fill in page 20 of the Student Handbook with your observations made at Oxley Nature Center or at your school.***

Pyramid of Life
(Teacher's Answer Sheet)

Suggested answers:



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Wetlands

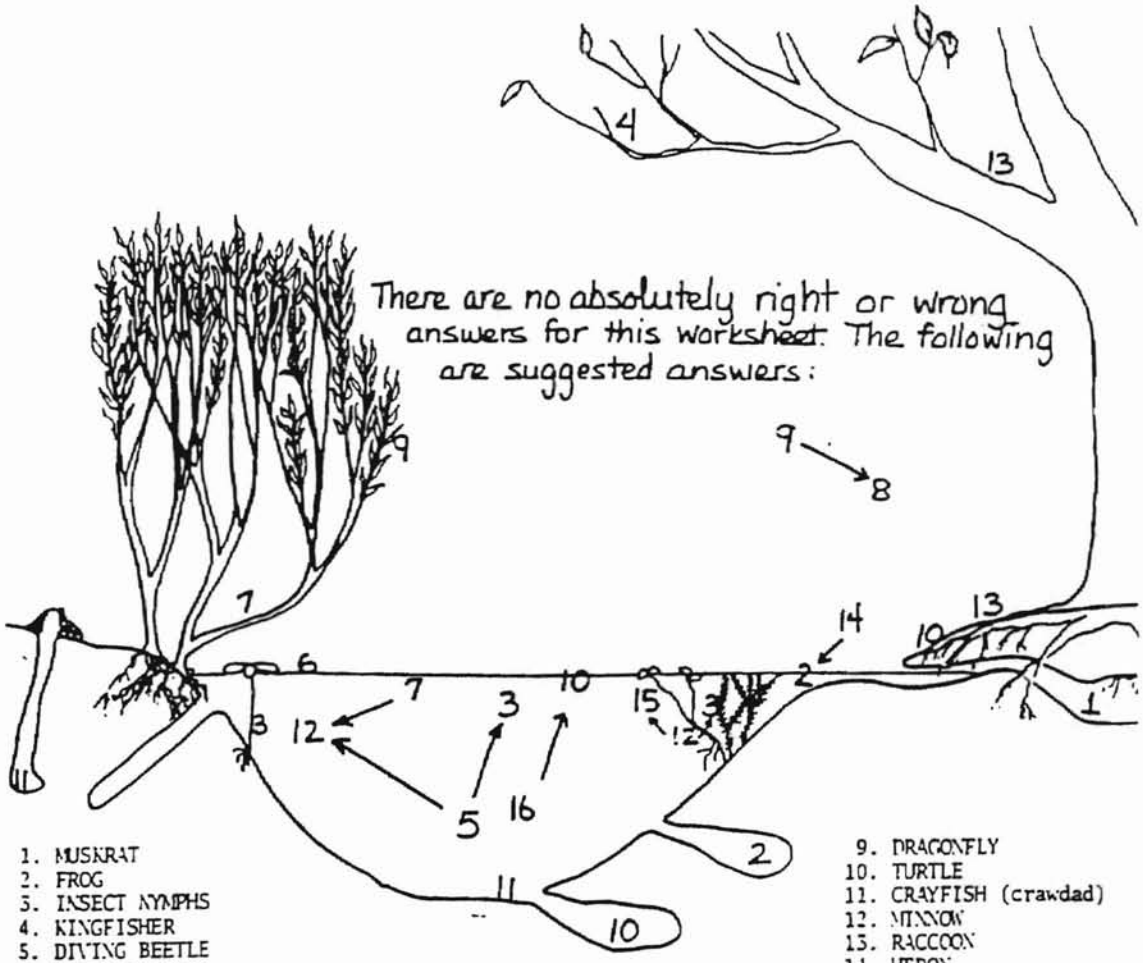
There are magnetic lines of force between children and water. Put any group of children down near any amount of water, and they will combine. You can put this irresistable attraction to work in the classroom.

Think back to the portion of the fieldtrip where the students explored one of the Nature Center's wetlands with dipnets. They will tell you right away what animals were caught and which ones got away. With a little more thought, they may be able to tell you just exactly where certain animals were observed and captured. Did the water strider fly above the water, glide across the surface of the water, or dive down to the bottom? Did you find snails perched over the water in trees, swimming in the middle of the water, or attached to plants? Where did you find dragonflies? Refer to pages 16-18 of the Student Handbook, for additional help. Use page 21 of the Student Handbook to mark exactly where each animal of the wetland prefers to live.

Besides helping your students to remember and organize their nature observations, this activity can introduce the concept of ecological "niche," which can be stated as "where it is, combined with what it does." To reduce competition for food and space, plants and animals find special places to live: the edge of a forest, in a hollow log, on the water's surface, inside the stem of a growing plant, etc.

❑ ***Activity Nine:*** ***Fill in page 21 of the Student Handbook with your observations made at Oxley Nature Center or at some other wetland.***

Wetlands
(Teacher's Answer Sheet)



21

Sharing Discoveries

Keeping a Nature Journal and making nature discoveries is more fun if you have a means of sharing those discoveries with others. A chart or scrapbook or class journal or bulletin board provides a place to write things down, to record observations, to read and ponder other people's observations. You may have to experiment with several formats; some students may be more verbal than others, while some prefer to make sketches and drawings.

❑ ***Activity Ten:*** ***Make place near your Touch-It Table where students can share and record nature observations made at the school and at home.***

Looking At & Listening to Birds

Birds and insects are the most easily observed animals for most children, and birds are active year-round. Bird houses are a frustrating school project because most of the observable activity takes place during the summer. Bird feeders, on the other hand, can be made from scrap boards, 2-liter pop bottles, milk cartons, pine cones and peanut butter, and will provide a great opportunity to observe wildlife up close. Besides the fun of watching the birds (or squirrels, or mice!) that visit the feeders, you can work the observations into art projects, descriptive writing topics, a variety of graphing and math activities, and so on. If you have more than two or three feeders in one location, you should probably number or name the feeders so that it will be easier to indicate which one is meant during discussions and excited observing sessions.

❑ ***Activity Eleven:*** ***Make a feeding station for your school. Stock it with scraps or bird seed, and keep track of the number and kind of animals that visit it.***

Animal Tracks

The easiest way to record or preserve a track is to make a circular collar out of poster board or strips cut from old file folders, place the collar around the track, pressing it into the dirt or mud so that no plaster can leak out of gaps, and then fill both the track and the cardboard collar with a mixture of plaster-of-paris and water. The plaster should be the consistency of pancake batter, and should be allowed at least several hours to set up and get firm before any attempt is made to pick it up. Let the plaster mold dry overnight before you wash the dirt and mud off the track. Many craft or nature project books give additional details.

Note: some children grasp the idea of footprints very readily, but seem to have trouble with a line or cluster of tracks. They seem to see each track as a separate event, unrelated to any other track in the vicinity. It takes a little work, sometimes, to make it clear that the animal took a step, then another step, and another step, then ran a little ways, then maybe took two steps backwards or turned around and shuffled its feet from side to side... In other words, they seem to think that 42 dogs made one track each, instead of one dog making 42 tracks! You might want to have them play some tracking games, letting teams of 2 or 4 children work together to make a "trail" and then have other teams figure out the trail.

❑ ***Activity Twelve:*** ***Look for animal tracks near your school, or make student tracks in dirt or sand. Make plaster casts of as many different tracks as possible.***

Water Holes to Mini-Ponds

This is one of the activities from OBIS (Outdoor Biology Instructional Strategies.) The class digs 2 holes, and lines each with a burlap-covered dishpan. Each "water hole" is filled with water, and some fertilizer is added to one. Once a week, each water hole is measured: temperature, light, water level, and the appearance or disappearance of life (or evidence of life that visits.) Maintain the water levels as needed. This activity can lead to discussions of colonization, animal life cycles, and the effects of chemicals on natural systems.

❑ ***Activity Thirteen:*** ***Set up two Water Holes and record your observations as they become Mini-Ponds.***

Terraria/Aquaria

It's very important in a closed ecology to provide all the needs of life. Your terrarium (plural: terraria) should have soil, air, water, and sunlight in a proper arrangement. Most terraria have a layer of pebbles and a layer of charcoal under the soil, and most do not need to be watered once green plants are put into it (where does the new water come from?) An aquarium usually has gravel, rather than soil, and unless you have a lot of healthy live water plants, you may need to oxygenate the water artificially with a bubble stone and electric aerator or aquarium pump.

Live animals are not necessary in your artificial micro-communities, but if you decide to include some for a specific educational project, aquatic animals such as small fish or crayfish are usually the most easily adaptable. If you keep a small toad or a praying mantis or a caterpillar in your terrarium, make sure it has enough room and suitable quantities and types of food. If the animals do not eat in a day or two, they should be released. Provisions should also be made for the animals' over-wintering, either making sure you will be able to provide food, or releasing them in time to make their own arrangements. And, at the end of the school year, captive animals should be released or provided for. It is probably best to keep animals only for a few days or a week, for specific projects. Be aware that there may be laws protecting certain kinds of wildlife, and always make safety for your students and for the captive animals a top priority.

❑ ***Activity Fourteen:*** ***Set up an aquarium or terrarium in your classroom.***

Nature Library

Nothing is cozier than settling into a comfortable corner on a rainy day with an interesting book! Your classroom library should include books of nature facts, as well as nature fiction. Some nature fiction, such as Incident at Hawk's Hill, by Allan W. Eckert, or My Side of the Mountain, by Jean Craighead George, make great story hour books for reading aloud to the class. A list of good books to start with is included here.

❑ ***Activity Fifteen:*** ***Make a Nature Library and Reading Corner in your classroom. Set up a Story Hour for your class, reading books together in exciting daily installments.***

RECOMMENDED BOOKS FOR A NATURE LIBRARY

Children's Books:

Allison, Linda	The Reasons For Seasons
Blaustein, E. & R.	Investigating Ecology
Brett, Jan	Annie & the Wild Animals
Burns, Marilyn	I Am Not a Short Adult!
Caney, Steven	Kid's America
Chinery, Michael	Enjoying Nature With Your Family
Cornell, Joseph	Sharing Nature With Children
Docekal, Eileen	Nature Detective, How to Solve Outdoor Mysteries *(Eileen used to work at Oxley Nature Center!)*
Dr. Seuss	The Lorax
Eckert, Allan W.	Incident at Hawk's Hill
Env. Action Coalition	It's Your Environment
George, Jean C.	My Side of the Mountain
Goble, Paul	The Gift of the Sacred Dog, and other books
James, Bessie Rowland	The Happy Animals of Ata-ga-hi
Jobb, Jamie	The Night Sky Book
Kipling, Rudyard	Just So Stories
Morrison, Gordon	The Curious Naturalist
Palmer, William R.	Why the North Star Stands Still
Parnall, Peter	Everybody Needs a Rock
Parnall, Peter	Hawk Is My Brother
Pettit, Ted S.	A Guide to Nature Projects
Selsam, Millicent	How to be a Nature Detective
Seton, Ernest T.	Wild Animals I Have Known
Sisson, Edith A.	Nature With Children of All Ages
Wilder, Laura Ingalls	The Little House series

Environmental Classics

Bates, Marston	The Forest & the Sea
Beston, Henry	The Outermost House
Carson, Rachel	A Sense of Wonder
Carson, Rachel	The Sea Around Us
Carson, Rachel	Under the Sea Wind
DeBell, Garrett	The Environmental Handbook
Dillard, Annie	Pilgrim at Tinker Creek
Fuller, Buckminster	Operating Manual For Spaceship Earth
Leopold, Aldo	A Sand County Almanac
McInnis, Noel	You Are An Environment
Storer, John	Web of Life
Teale, Edwin Way	Autumn Across America
Teale, Edwin Way	Journey Into Summer
Teale, Edwin Way	North With the Spring
Teale, Edwin Way	Wandering Through Winter

Good Sources for Environmental Education Materials

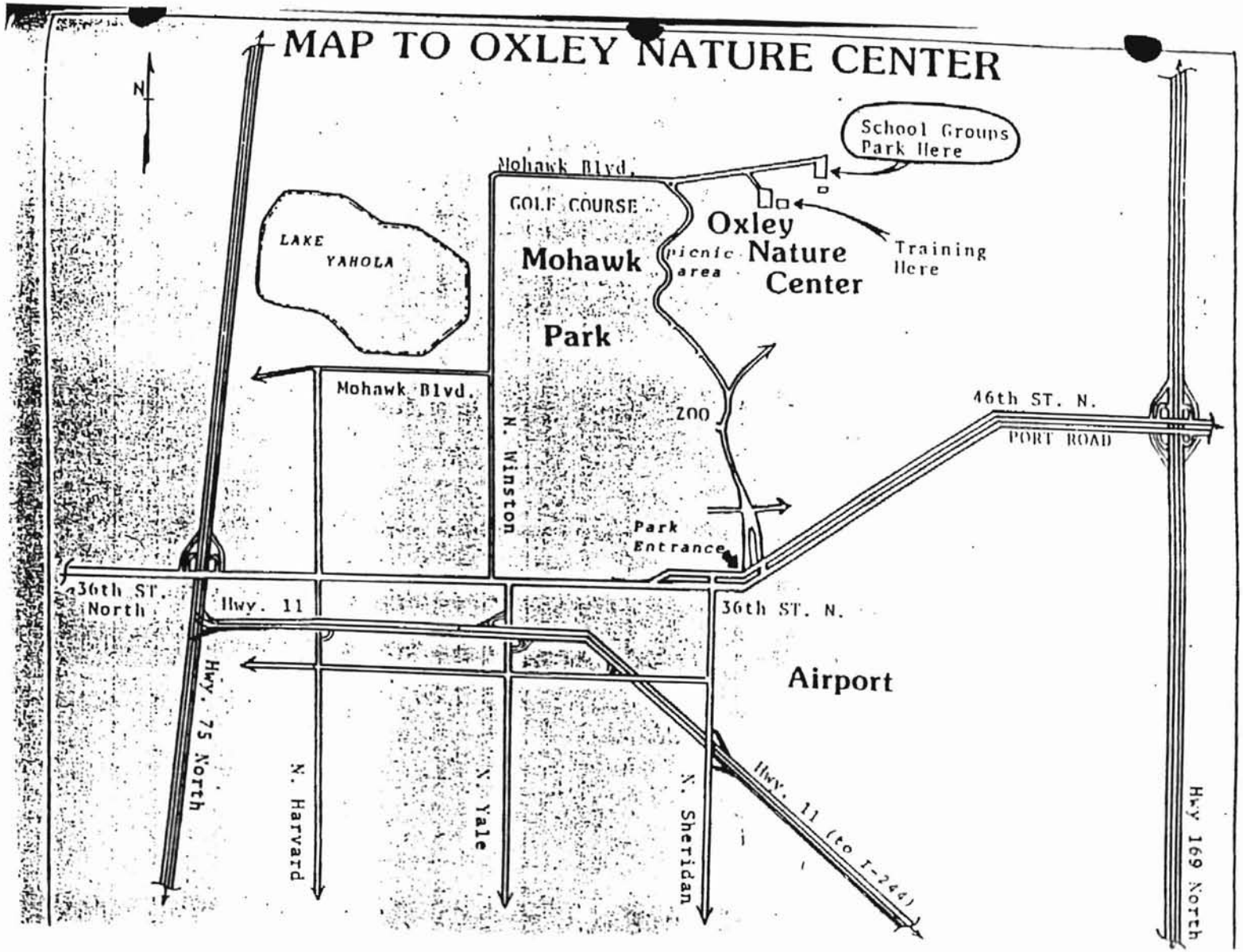
Project Learning Tree
Looking for a way to get your students excited about math or geography? Wishing you had a new way to build your students' communication and group decision-making skills? You could use these excellent forest ecology materials and interdisciplinary curriculum enhancement activities for teachers, program directors, or youth leaders. You will take home a manual with more than 80 different hands-on activities. Cost $5. You must attend a workshop to get the PLT materials. Sponsored by the Oklahoma Department of Forestry and the Oklahoma Conservation Commission.

Project WILD
The sequel to Project Learning Tree, Project WILD focusses on wildlife and its habitat needs and uses students' interest in wild animals to teach lots of skills and lots of different subjects. You get two manuals full of hands-on, interdisciplinary, curriculum enhancement activities for teachers, program directors, or youth leaders. You must attend a Project WILD Workshop to receive these materials. Cost $5. Sponsored by the Oklahoma Department of Wildlife Conservation (405-521-3855) and the Oklahoma Conservation Commission.

The CLASS Project
Useful environmental education materials developed by the National Wildlife Federation, especially for middle school teachers. Hands-on, interdisciplinary, curriculum enhancement activities cover six different topics: Energy Use, Forest/Watershed Management, Hazardous Substances, Wetlands, Wildlife Habitat Management. Each topic area begins with introductory activities and concludes with putting new skills to use in decision-making activities. Cost $8. Note: since these materials have gone out of print, you may not be able to order them any more. Write to National Wildlife Federation.

OBIS (Outdoor Biology Instructional Strategies)
Available from the Lawrence Hall of Science in Berkeley, California, the OBIS packets are self-contained lesson plans for a wide variety of hands-on biology projects and teaching games. Cost ?? (rumor has it that the cost has gone way up)

For more information on any of these programs, call 669-6644.


MAP TO OXLEY NATURE CENTER
N
School Groups Park Here
Mohawk Blvd.
GOLF COURSE
LAKE YAHOLA
Mohawk Park
Oxley Nature Center
picnic area
Training Here
Mohawk Blvd.
N. Winston
ZOO
46th ST. N.
PORT ROAD
Park Entrance
36th ST. North
Hwy. 11
36th ST. N.
Airport
Hwy. 75 North
N. Harvard
N. Yale
N. Sheridan
Hwy. 11 (to I-244)
Hwy 169 North

oxley nature center

APPENDIX C:

TESTING INSTRUMENT

Some Ideas--Environmental Orientations Inventory
Horvat and Voelker

For each question, circle the answer you think is the most correct or the best.

1. I am a:
girl boy

2. I am _____ years old right now. (put your age in the blank)

3. I live in:
an apartment a house

4. I worry about the environment (problems like pollution).
Yes No I don't know

5. If a person's car makes too much air pollution, he or she should not be allowed to drive it.
Yes No I don't know

6. I think there are a lot of pollution problems I can help stop.
Yes No I don't know

7. Soda pop should be sold only in bottles or cans that can be used again.
Yes No I don't know

8. If wild animals need a safe home, it would be best to put them in a nice zoo.
Yes No I don't know

9. Milk at school should come in bottles that can be used again, not in paper cartons.
Yes No I don't know

10. If my family owned wetlands or woods where some animals lived, I would like part of it made into a playground (like at school).
Yes No I don't know

11. There is too much on T.V. about problems with pollution.
Yes No I don't know

12. Children worry too much about problems of the environment (like pollution problems).
Yes No I don't know

13. We have enough parks and forests now for wild animals to live in.
Yes No I don't know

14. You should use a lot of weed killer on your lawn, so you won't have to have so many weeds to pull.
Yes No I don't know

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15. My family and I recycle everything we can.
Yes No I don't know

16. I encourage others to recycle.
Yes No I don't know

17. If I see a bug on the ground, I will kill it. Bugs are not that important.
Yes No I don't know

18. If I see a bird's nest in a tree, I will try to get it to show other people.
Yes No I don't know

19. One kind of a producer is:
a tree a person a tiger a bug

20. One kind of a consumer is:
a flower a tree a person a plant

21. An animal that lives in a wetland community is:
a deer a racoon a grasshopper a frog

22. Nocturnal animals:

a. sleep at night and come out in the daytime

b. sleep during the day and come out at night

23. Are we part of the food chain?

yes no

24. Is a spider a part of the food chain?

yes no

25. Herbivores eat:

only meat only plants both meat and plants

26. Carnivores eat:

only meat only plants both meat and plants

27. Most people are:

herbivores carnivores omnivores

APPENDIX D:

OKLAHOMA STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD APPROVAL

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 10-10-97 **IRB#:** ED-98-020

Proposal Title: THE EFFECTS OF AN OUTDOOR MYSTERY GAME ON ELEMENTARY STUDENTS' ENVIRONMENTAL EDUCATION

Principal Investigator(s): Lowell Caneday, Elizabeth S. Lyons

Reviewed and Processed as: Expedited (Special Population)

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Signature

Chair of Institutional Review Board

Date: October 15, 1997

cc: Elizabeth S. Lyons

APPENDIX E:

TULSA PUBLIC SCHOOLS APPROVAL

October 27, 1997

Liz Lyons
1567 Southwest Blvd. #2 - d
Tulsa, OK 74107

Dear Ms. Lyons,

I am pleased to report that we have approved your student survey about the environment.

As required by state law, parental permission must be secured. Participation is to be voluntary on the part of principals and teachers, as well as students.

Congratulations on arriving at this stage of your graduate work, and I wish you continued good luck.

Sincerely,

Jerry Roger

Jerry Roger, Director

Planning and Assessment

Tulsa Public Schools

Approved: Dr. Carol Caldwell

3027 SOUTH NEW HAVEN P.O. BOX 470208 TULSA, OKLAHOMA 74147-0208 (918) 746-6800

VITA

Elizabeth Jeanne Stifel Lyons

Candidate for the Degree of

Master of Science

Thesis: THE EFFECTS OF AN OUTDOOR MYSTERY GAME ON FOURTH GRADE STUDENTS' ENVIRONMENTAL EDUCATION

Major Field: Environmental Science

Biographical:

Personal Data: Born in St. Louis, Missouri on April 1, 1971, the daughter of Perrin and Alice Stifel.

Education: Graduated from Webster Groves High School, Webster Groves, Missouri in June, 1989; received Bachelor of Science degree in English Education from the University of Missouri-Columbia, in December 1993. Completed the requirements for the Master of Science degree with a major in Environmental Science at Oklahoma State University in July, 1998.

Experience: Taught seventh grade English in Edmond, Oklahoma for three years; wrote the Katy Trail State Park newsletter for Missouri State Parks in the summer of 1996.