AQUATIC STUDY FIELD TRIP: BENEFITS AND EVALUATION

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ABSTRACT

In this project an aquatic field trip resource is developed for both elementary and secondary teachers to use in their classes and at a pond site. It uses the compulsory activity from the grade 11 general level environmental science course as a model. Abiotic factors are measured and water organisms are surveyed so that the water quality can be determined.

This study evaluates the effectiveness of a field trip to a pond in meeting the Ministry of Education science course objectives and looks at evaluation methods for the purpose of improving the learning experience for students. A report is given of water quality parameters as presented to the community of teachers who would possibly be using the site and a questionnaire given to survey their reactions and ideas about this report. To assist teachers further, a list of resources to help with this unit was developed from material gathered as the project took form.

To put the unit and its teaching into a provincial focus and to gain practical ideas that would make teaching and preparing for the field trip more successful, a survey was done outlining the programs of similar centres nearby. Unfortunately, low data sets of students in the course could not reliably yield any scientific conclusions. The reactions of students to the activity, the historical background to this type of educational activity, and the positive effect of this additional tool in teachers' professional toolkits (Miles, 1990,), shows this a worthwhile activity to undertake.

The project did allow development of a detailed guide to aquatic organisms

that can be used by teachers wanting some assistance teaching this unit. With changes by the current government, this particular course will not be offered again after the '98/99 school year. Courses at the elementary level will find this information helpful. Courses at the secondary level are currently being developed that should include units where this resource could be used.

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My thanks go to my family, to my wife Janet, daughter Mary, and sons Robert and Michael. Their support and patience went far beyond their young ages and was held together by their mother. It will take some time to repay their sacrifices but that happy process can now begin.

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INTRODUCTION

A grade 11 general level environmental science course has as a compulsory activity "the analyses of water from a nearby body of water ...*for abiotic factors*, such as temperature, oxygen, pH...". Further, the water organisms are to be surveyed and the water quality determined from their presence. Students are expected to have various skills in analyzing water, recording data, and interpreting the data, and to develop an appreciation and respect for aquatic species and ecosystems and how they are affected by the water quality. This study evaluates the effectiveness of a field trip to a pond in meeting the Ministry of Education course objectives and examines techniques in the evaluation process. The intent is to identify areas that can be improved to make this a better learning experience for students so that ideas can be used with a follow-up trip with another class in September and with classes from other schools, with other teachers as well.

The potential for change and improvement in this unit is one aspect of why it was selected for a project. Additionally, continued support from the Oxford County Board of Education for the outdoor program is another factor. The only microscopes available in the classroom of the two-room schoolhouse are very small versions called "elementary scopes" that are not very suitable because of poor light transmission through their small apertured objective lenses. The possibility of change has already inspired this study with the intent that other teachers in the board will bring their classes to the centre and further support for the program will follow from the board administration if the environmental education site and its programs are being used by

many classes and a large number of students.

The rationale for teaching this subject matter in an outdoor setting is looked at from several aspects, personal, historical, and educational. These various aspects are linked in the educational method now known as experential and this methodology and its benefits are examined.

The field trip itself is then presented, followed by method to evaluate its effectiveness as an educational experience.

To put the unit and its teaching into a provincial focus, a survey was done outlining the programs and methods used by similar centres nearby and by the recognized "standard" of provincial centres in program quality and duration, the Boyne River Natural Science School near Shelburne. These findings were used to sift out the practical ideas that would make teaching the unit more effective and safe in a shorter time.

Recommendations and conclusions to make the pond field trip continue as an effective educational experience are presented.

To assist teachers further, a list of resources to help with this unit was developed from material gathered as the project took form. It includes both print and video resources and Internet sites. Consideration for using computers and the Internet as a resource in environmental science is presented.

CHAPTER 1:

RATIONALE

Why Study Ponds?

The Aquatic Ecosystem unit is a compulsory part of the grade 11 general Environmental Science course which taught at Huron Park S.S. in Woodstock. Until recently there are no second-generation documents available for any of the Environmental units, just the curriculum guideline published by the Ministry of Education. (A second generation document augments the Ministry Guidelines by putting the material in the setting of the local area. This document can then be developed further by individual teachers in schools into a third generation document which is used directly for their unit and lesson plans.) To remedy this situation, second generation curriculum guides teachers generally call "User Guides," have been developed for the three general level environmental science courses (grades 10, 11, and 12) in Oxford County. These are meant to help teachers prepare their course unit plans and lesson plans (third generation). These User Guides are now being followed up with a detailed package, a level three document to guide the teaching of the Aquatic Ecosystem pond study field trip, specifically as it can be done in Oxford County with our own Outdoor Education Centre. The resource could also be used in the grade nine science course which has an ecology component and in several parts of elementary courses.

Reasons for doing this project on a pond ecosystem field trip include:

1. The unit is compulsory in the Ministry of Education Course of Study for the grade

11 environmental science course (SEN 3G). Reasons for this inclusion will be dealt with later.

2. I have always liked ponds and find that liking a topic a great asset in any area that I teach. I have always liked them on a personal level as a place to explore, to "muck around in" and see what is there. Ponds are easy to do this with as they are usually fairly accessible and usually have shallow areas where you can poke around and the creatures you find don't have too many places to go so they are fairly easy to observe and even capture. It is like looking into a big aquarium — and aquaria are a little taste of a pond you can bring into the classroom to get students warmed up to the bigger pond idea.
3. As a teacher I find that students like ponds as well. They are fairly easy for them to explore and when they find creatures there, the, "Oh, look at this!" comments and, "Wow, look at that!" comments are music to a teacher's ears. To me, these comments are signs that students are finding and becoming aware of things they have not seen before and which appear to be significant to them.
4. Teachers on the other hand are often without experience in many outdoor areas; especially those involving water. Water tends to hide the organisms and ecological relationships that occur there. Help for these teachers in a compulsory part of this course is another reason for doing the project. Ontario classroom teachers have said they need help due to lack of preparation time, not having suitable materials for instruction, and not feeling very confident about their abilities in this subject area (Eagles & Richardson, 1992, p. 12)

5. A pond was chosen because we have no stream to select as an aquatic study area. A stream would not fit as well with some of the suggested classroom activities of building aquariums to model pond life and observe the pond organisms, test the water quality and observe eutrophication changes. If you are doing this work in the classroom then the pond is the natural follow-up in the field — it is, literally, a big aquarium. Some teachers find a stream more exciting because the creatures have different adaptations to the current and rocky bottom. Mostly it comes down to accessibility to you and your students. If you teach beside the Grand River or a stream directly below your classroom as Glendale H.S. in Tillsonburg has, then you will likely focus your study there. In Woodstock, the Thames River is dammed. During the spring and fall it is a temporary lake and during the late fall and very early spring it is an empty lake with exposed mud bottom and barren stream meandering through the centre — and not suitable at all for students to approach and study.
6. There has long been support for outdoor centres and field studies of this kind. Many boards of education in Ontario have taken the time and put financial support behind these programs to purchase land, build facilities to teach students, and hire permanent staff. Often these facilities house students overnight, or for several nights, in rural areas away from their normal urban classrooms (Eagles & Richardson, 1992).

The Toronto Island Natural Science School first opened in 1960. Since then, to 1988 and 1989 when the only comprehensive provincial study was done by Eagles and Richardson, the involvement of students in outdoor/environmental education had

not been checked by any formal study. In each of these two years, 1988 and 1989, it was found that 332,000 students had taken part in these "experiential education" programs. Out of 172 boards in the province, many had programs without a formal policy, 28 had such a policy, and 46 boards in all operate their own outdoor education centres. Eight boards reported in this Eagles & Richardson study that 50% of their students had received one day of instruction in the year before (1992, p. 12). No studies have been done since.

7. At the start of this project in 1993, the Oxford County program was in transition and support was needed for the board's policy of maintaining the site and keeping the program active. With the retirement of the "Field Studies Centre" teacher, the board hired a new, much younger instructor, Brian Grigg. A new person in residence at the centre would be an ideal opportunity to help develop a new area of the program. The emphasis had shifted to serve an almost entirely elementary student body, the area with which Mr. Grigg was most familiar. At both the elementary and secondary level, there was no written program available for this area of study (water quality/pond study) as had been present in the distant past.

8. Another reason for pursuing the study was to provide academic and pedagogical arguments to support the continued funding of the program at the centre. Mr. Grigg was hired as a non-teacher and, as such, could allow a substantial cost saving. Fears that the next cost cutting might be the centre itself if strong reminders of its worth and benefit were not presented to the board provided another reason for this project. The field trip guide which teachers could use would make it easier for teachers to use the centre with their students. Use by students is one

of the main financial considerations boards study at budget time.

9. Students, in studying a pond, can use the methods working scientists would use to gather their data. They can analyze these data using computers in the same way working scientists would analyze their data. Data can be manipulated into graphs with these methods and the information can be used to move into broader issues like biodiversity, water quality and pollution. Students would gather all this information from the beginning, it would be "theirs", not handed out on paper by the teacher. A bonus to this is that these activities and skills also meet requirements of the Ministry of Education Science Guidelines.

An Update

It should be noted that the situation described above was in place when this project was started in the spring of 1994. Now, four years later, there is a new instructor, Patti Donnelly. Along with other changes to Ontario's education system, the Oxford County Board of education has amalgamated with the London Board, Middlesex and Elgin County Boards to become the Thames Valley District Board of Education. London, the largest board in this group, has over the past few years dropped programs and closed operations at some of their outdoor education centres. With the new funding formulas being uncertain at present, there is probably more need for this argument for outdoor education programs in Ontario schools. The SEN 3G course for which this project was developed will be offered for the last time in the 1998/99 school year and after that there will be no separate environmental science courses offered at the secondary level. The project material could be used at the elementary level where the "ecosystem" unit has been moved. There may be opportunity to use it in some second-

ary science courses which are currently being written.

We will look at the educational reasons why these courses and learning situations have been set up in the past.

CHAPTER 2:

EDUCATIONAL BACKGROUND AND RATIONALE FOR A POND FIELD TRIP

The Historic Context: Locally –

Locally, the Oxford County Board of Education has been supporting "Out-of-School Education" for some time. An undated and unsigned Oxford County document found in school files dating from the 1970's, states the purpose of Out-of-School Education services to be:

> B. Purpose:
> Young people often have difficulty transferring what is learned in the classroom to out-of-school situations as a result of the tendency to limit formal learning to the classroom environment. In other words, because of an over-emphasis on learning in a classroom situation, children may not be fully aware of the relationship between much of what is learned in school and the world outside the school building. To help overcome this problem was the basic purpose for the establishment of a Field Studies Centre and the provision of an Out-of-School Education Co-ordinator by the Oxford County Board of Education.

Some of the "Services Available" and "activities" include those which would support the pond study field trip. As stated in the handout these are:

> C. Services Available:
> 1. Consultations with teachers with respect to the use of school-grounds and nearby natural areas for field studies in applied science. (A teachers' guide, *The Educational Resources of Oxford County*, has been prepared to point out the almost unlimited opportunities for field studies in Oxford County
>
> 4. At the County Field Studies Centre the following activities are offered:
>
> d) A one-day course in water-quality testing, consisting of a lecture and a laboratory session on testing water for phosphates, iron, oxygen, carbon dioxide, etc. (Grades 11 to 13)
>
> e) A one-day course in water-quality, consisting of a lecture and a laboratory session on bacteria and algae.

Millipore techniques and apparatus are used to test for total and coliform bacteria counts. (Grades 11 to 13)

g) A one-day field and laboratory course in pond and stream studies (food chains, water velocity, turbidity, pH., etc.) (Grades 8 to 13) (*Stream site not specified!)*

The board produced, with the work of the then Out-of-School Education Coordinator, Bessel J. VandenHazel, the detailed listing of available resources from across the county, detailing types of activities that could be carried out at each location. Many of them listed pond or stream study sites.

The Oxford Board's support for this type of activity was exemplified by a resolution passed December 1st, 1970 at a Tuesday Board meeting approving a field trip by 30 secondary students and several teachers to St. Andrews-by-the-Sea, New Brunswick. Duration of the course was to be three weeks in July of 1971. It provided a credit in marine science and included over half the time be devoted to laboratory and field work.

Although the purpose of the Oxford County program is stated as being to make students aware of the relationships between what is learned in school and the world outside school, it is still only history. I found no evidence for any academic proof of any kind that this awareness actually happened. No evaluation forms for any programs have been found in files from around the county.

The Historical Context: Provincially –

That outdoor education has clear benefits for students is the opinion shared by other educators in the field. In the "Outdoor Education Manual: Part I, prepared by The Ontario Teacher' Federation (OTF) Outdoor Education Committee, 1970," there are 7 educators from around the province who have contributed to the manual and a

list of 14 more teachers acknowledged for their support.

In the introduction to this document the challenge of making studies relevant for students is made easier by dealing with difficult concepts in an outdoor setting. The document states:

> The school is faced with the challenge of making studies more relevant to students. Probably the most pressing issue of our day is the deteriorating quality of our environment. Our children should be made aware of the fact that all of their food is derived from green plants. They should understand the delicate balance which controls all living things, and their own place in this system. These concepts are very difficult to teach to children if they are not given opportunities to observe life and growth in the outdoors. (OTF Manual, Babcock, W., Chair, 1970, p. 84)

The manual summarized that there are certain experiences that "cannot be done indoors."

This 1970's era committee's survey of teachers' reasons for going outdoors is categorized into several areas: Reality, communication and social interaction. Under each area they summarize:

1. REALITY

> The natural or man altered world cannot be duplicated in the classroom. A child may learn the book definition of something, but it is doubtful if he really understands it. A biology teacher, when shown liverwort in the woods, commented, "Is that what it looks like? I have been teaching that for 14 years and this is the first time I have seen it." What understanding then, could his students have had of the plant?
> Teachers want children to experience the sights and sounds of birds in flight, the comings and goings of the bees from a hive, the sweet taste of maple sap, the bright colours of autumn trees, and the sparkling heaven full of countless stars as it appears away from city lights and smog. They want children to stand in the middle of a measured acre and fix forever in their minds what size it is. They want children to discover the many and varied forms of life which are to be found in ponds and streams. They want children to get involved in studying the pattern of traffic on the nearby streets and roads, and the trends in agriculture, industry or commerce which influence their

community. In short, they want children to observe their surroundings and make sound judgements on what they observe.

In the area of communication:

2. COMMUNICATION

Teachers find, when they have students outdoors, that a feeling of freedom develops without the barriers imposed by walls and furniture. In such an atmosphere the students communicate more readily with each other and with the teacher. With this easy communication comes a new understanding of other people.

Consider the case of the kindergarten teacher who had a boy in her class, whose voice she had still not heard by November. On a field trip in a natural area the boy began talking to the teacher and never reverted to his old pattern of reticence.

The implications for guidance in this area are obvious. With greater freedom of communication it is much easier to determine the cause of student problems, and the student is more receptive to advice given in the less formal environment outdoors.

Social reasons for going outdoors are stated as being:

3. SOCIAL INTERACTION

The situations which occur outdoors allow for social interaction between students, and between teacher and students in real life situations. With this comes a greater appreciation of others.

The natural world is a wonderful leveller. Often children are heard to remark on a first field trip, "I didn't know teachers had old clothes! "

On a particular occasion as a class returned from a lengthy hike, a light rain began to fall. In a true spirit of democracy it soaked the teacher as well as the students, and at this point the teacher heard a boy behind him on the trail comment, "He looks just like one of *us.*"

A grade nine student recently wrote after an outdoor education experience: "What impressed me most was that many of us showed another side of our personality. Some who are leaders in class became timid outdoors. Some of the least likely students became the leaders. Several of the boys who, we thought, had no feeling for others stopped gently to help classmates up the icy slopes."

Many cases could be cited of new and better relationships which develop outdoors. If the change is as obvious to a grade nine student as the above quotation shows, then a

> teacher should be able to see these things happening too. Some teachers deliberately place students in situations which require the co-operation of several students. Others who do not plan such activities should nevertheless capitalize on them when they arise. Some of the activities which require co-operative effort include, (1) making a cook fire and preparing a meal, (2) climbing a particularly steep bank or rock face assisted by a rope, (3) pursuing academic studies on a team basis and (4) co operating on initiative tests, where a group must work together in order to solve a problem in a fixed period of time.

The document makes no mention of how the experiences were evaluated other than personal observations of teachers. The grade nine student's writing is not categorized as being solicited or not, nor in what type of format it was submitted. Was it an open letter or a field trip debriefing outline from the teacher? The main method used, from reading this manual and from personal recollections of talking to people at outdoor centres about this time, while attending the Faculty of Education at Queen's in 1973, was that they used an informal group consensus for these ideas.

Whether this can be considered valid is another matter. They all worked in the field and thus all had a personal interest in the centres' continuing their operation. (Beyond the past few years with their budget cutbacks, there has been no threat to any programs, only growth. Several boards, Waterloo and Durham in particular, established up to four centres in their areas.)

Evaluated or not, this document appears to lay the groundwork for many of the goals, aims and objectives to be found in future Ministry of Education science documents and, in fact, for the entire science program as well.

The 1970 committee's stated "Aims and Objectives of Outdoor Education" include:

1. Education in the out-of-doors creates a learning situation for all ages in which actual experience leads to self-inquiry and discovery in a variety of disciplines.

2. Outdoor experience provides a real-life situation for problem solving and developing those skills necessary to adapt to changing life conditions.

3. The outdoors provides a neglected dimension for the promotion and encouragement of independence, resourcefulness, flexibility and creativity.

4. The out-of-doors experience encourages the promotion of concepts leading to the wise use of natural resources.

5. Group experience outdoors provides the physically healthy environment in which the opportunity is presented for promoting those basic virtues and values necessary for modern democratic living. (OTF, pg. 6)

This looks like an excellent medium for any teacher to use to give a quality educational experience to students. They could develop as individuals form their experiences in different learning situations, not only in self discovery but also in independence, resourcefulness, flexibility and creativity. Their problem solving skills would be developed in "real-life situations." Not only are individuals said to develop in the out doors but individuals develop as group members because the group experience provides lessons in democratic living.

The latest science documents still use the "wise use of natural resources" as one of their major goals.

The 1970 OTF document goes on to summarize the "abstract concept" of conservation as the sum accomplishment of years of accumulating short experiences in the out-of-doors:

> Conservation alone is an abstract concept: it is a way of life in practice. The decision to follow the latter is one of choice based on informed attitudes. Our schools need to find the best way of developing these attitudes.
> Since conservation is neither a science nor a discipline, it is unnecessary to consider it as another unit for inclusion in an

> already burdened academic year. It is an attitude of mind which should be cultivated in a variety of present programs. Conservation, however, conveys more, both intellectually and emotionally, when related to concrete situations. Most of these are found out-of-doors.
> Outdoor studies of an interdisciplinary nature provide suitable opportunities for understanding the biological and physical structure and development of the landscape, and the interaction of man and his environment. Within this context, the reasons for conservation become more apparent and assume significance.
> Involvement with the environment precedes kindergarten and extends beyond secondary school. During the formative school years a child's earlier exploratory experiences are used as he is encouraged to broaden his knowledge of the environment. These activities, initially isolated and unrelated to each other, gradually become an accumulated body of knowledge. This knowledge, with appropriate guidance, begins to contribute meaningfully to the student's better understanding of the environment. It is the basis for more mature studies in secondary school.
> By the end of their secondary school years, students should be able to recognize the need for conservation. If this need is based on informed attitudes, sound decisions will be made by them in their future private and public responsibilities. They alone can make the choice of their way of life. Our schools must lead them to make that choice wisely.

The end result is the student's ability as an adult to make sound decisions for themselves and society based on the ingrained ethic that these school programs have fostered in them. It looks very similar to the "environmental ethic" the 1987 curriculum document refers to in the next section.

The Historical Context: From OTF Manual to the Current Ministry Science Courses

The "environmental ethic or emphasis" is the sum of Science Curriculum Aim 5: "respect for the environment and a commitment to the wise use of resources," plus the content from the individual course of study. Further details of Aim 5 of the science curriculum are:

> The science program should enable students to develop an

> environmental ethic that incorporates:
> - an empathy with nature and its complex interactions;
> - a respect for living things;
> - a consideration of the effects of actions on the environment;
> - an understanding of the needs and desires of human beings and how these influence environmental decisions.
>
> (Science, Pt. 1, 1987, pg. 11)

We have "understanding of the biological and physical structure and development of the landscape," paired with "an empathy *(understanding?)* with nature and its complex interactions". When ecology is looked at, it has both biotic (the biological or living) and abiotic (physical) parts. These together make up the ecosystem which, when matched with the landforms (the landscape), are called biomes.

The next point in the 1970 document, "the interaction of man and his environment," can be paired with the final two points in the ministry Part 1 document, "a consideration of the effects of actions *(interactions)* on the environment," and "an understanding of the needs and desires of human beings and how these influence environmental decisions." Both of these last two points are describing how humans interact with the environment and the effects of these interactions. The second detailed point in this aim, "a respect for living things," as well as the wording of the aim itself, "respect for the environment and a commitment to the wise use of resources," surely summarize the core of the conservation ethic. I link respect to the "attitude of the mind which should be cultivated," from the 1970 manual. This is a positive commitment to the environment, still dealing with an abstract term (respect), just as conservation is an abstract term. And just as this aim mentions the "wise use of resources," so to is this implied in the conservation ethic. We are saving the resource, looking after it, for later use.

Because the "respect" for the environment and its older namesake, "conservation," are both abstract concepts, how does a teacher evaluate whether or not students have embodied them? Evaluate them you must, so it states in the current Ministry of Education Curriculum Guideline, Part 1, 1987, on page 15.

> Teaching for the major aims in addition to science content is a challenge. The challenge can, however, be met if the teacher:
>
> a) chooses the curriculum emphasis to go with a given unit of required science content;
> b) balances the range of emphases throughout students' science education;
> c) evaluates student achievement on the basis not only of content but also of curriculum emphases.

The first two points rely on all previous teachers or your students to have done their part. The third point (c) says you have to evaluate students in your environmental science course for their "respect for living things." Evaluating this facet of students will be dealt with in a later section.

This concludes the historical review of doing field trips in the out-of-doors. There does seem to be a lot of support for these activities, both around the province and in Oxford County. Now to look beyond Ontario for similar support before examining the official Ministry of Education reasons for the pond field trip.

CHAPTER 3:

ORIGINS BEYOND ONTARIO

Outdoor education from which environmental education has evolved has a world-wide basis. The UNESCO Environmental Education Workshop in Belgrade in the early seventies adopted a policy to present to the international community. Among the goals were mentioned that humans had to get along in the total environment, with nature and each other and be aware of environmental problems and solutions. This sounds very similar to the Ministry of Education's environmental curriculum in Ontario. It sounds even more familiar when the terms "knowledge, skills and attitudes" are listed with the specific purpose of solving environmental problems.

The UNESCO workshop offered these as international goals (Link, 1981, p.33):

1. To improve the relationship of humanity with nature and human beings to each other:
   a) For each nation, according to its culture, to clarify for itself the meaning of such basic concepts as "quality of life" and "human happiness" in the context of the total environment, with an extension of the clarification and appreciation to cultures beyond one's national boundaries,
   b) To identify which actions will ensure the preservation and improvement of humanity's potentials and develop social and individual well-being in harmony with the biophysical and artificial environments.
2. To develop a world population which is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions to current problems, and the prevention of new ones.

Objectives from Belgrad include:

1. Awareness: To help individuals and social groups acquire strong feelings of concern for the environment and the motivation for actively participating in its protection and improvement.
2. Knowledge: To help individuals and social groups acquire basic understanding of the total environment, its associated problems and humanity's critically responsible presence and role in it.
3. Attitude: To help individuals and social groups acquire social values and the ability to make sound choices while developing in them a sensitivity to the environment.
4. Skills: To help individuals and social groups acquire the skills for solving environment problems.
5. Evaluation Ability: To help individuals and social groups evaluate environmental measures and education programs in terms of ecological, political, economic, social and educational factors.
6. Participation: To help individuals and social groups move toward taking the necessary action to resolve environmental problems.

This conference in Belgrade also defined principles to guide an environmental education program (EE):

1. EE should consider the environment in its totality—natural and artificial, ecological, political, economic, technological, social, cultural and aesthetic.
2. EE should be a continuous life-long process, both in school and out of school.
3. EE should be interdisciplinary in its approach.
4. EE should emphasize active participation in preventing and solving environmental problems.
5. EE should examine major environmental issues from a world point of view while paying due regard to regional differences.
6. EE should focus on current and future environmental situations.
7. EE should examine all development and growth from an environmental perspective.
8. EE should promote the value of local, national and international cooperation in the solution of environmental problems.

From the above objectives and principles we have the life-long process also found in the Ontario curriclum, there is the "conservation" ethic of concern and actively

protecting the environment, the interdisciplinary aspect and necessity of environmental education, and the working as individual and as groups, including whole societies and cultures to solve environmental problems. Whether or not this conference and document led to the development of the curriclum material in Ontario is not the purpose of this study but the timing and intent, down to the terminology are certainly appropriate for this conclusion.

The policy statements and intent from Belgrade were taken up by the United States when it outlined the need for outdoor classrooms in 1973. The National Education Association's resolution states, among other things, that education programs should be for the "use, stewardship, and preservation of a viable environment." The term "stewardship" is closely related to the concept of conservation. Their resolution promotes the support of environmental programs at the affiliate or local level and this was done in many states, including Minnesota, Iowa, Colorado, Michigan, and Illinois (Link, p. 33). Included in the objectives from Iowa is: "3. The student will gain knowledge about the basic environmental concepts that affect life including the conservation of natural resources." Here we have two of Ontario's aims and objectives included together. Others, common to both Ontario and some U.S. states are the ability to think critically and realize the societal implications of activities in the environment. "Societal implications" incude an entire separate category listing in the Ontario curriculum.

Ontario has not been alone in this curriculum development. Support has been from the international community and it is still worthwhile offering it here.

CHAPTER 4:

MINISTRY OF EDUCATION SCIENCE DOCUMENTS: OFFICIAL REASONS FOR THE POND FIELD TRIP

Value and Purpose of Science Education

In the Ministry of Education Science Curriculum Guideline: Intermediate and Senior Divisions, 1987. *Part 1: Program Outline and Policy*, Section 1, there are three levels of listing the material and experience students will encounter in all science course. The first level gives the "Value and Purpose of Science Education", next there are "Goals" and, finally, "Aims".

The Value and Purpose of Science Education is seen to have a sociological aspect. Some of the needs of the students and society that science can help them meet are (p. 6):

> f) survive on this planet;
> g) utilizing natural resources wisely and efficiently;
> i) solving interrelated environmental, political, social, economic, scientific, and technological problems.
> k) maintaining a positive outlook on life and recognizing the benefits that science can bring to enhance life on earth.

The above are the overall policy statements for science, the ones with environmental overtones, at least. They certainly sound in synch with the earlier UNESCO environmental workshop in Belgrade and those from the United States. They also give the background reasons for doing a science activity like the pond aquatic study.

Beyond these values and purposes are the two other divisions, "Goals and Aims", both of which are quite repetitive.

Goals of Education and the Role of Science

Section 2: The **Goals of Education and the Role of Science** list as number 12: to help students "*develop respect for the environment and a commitment to the wise use of resources.*" It goes on to state "This goal relates to a knowledgeable concern for the quality of the environment, the careful use of natural resources, and the humane treatment of living things." This "environmental ethic" that students are to develop is to be taken in as part of their behaviour the curriculum states (p. 9). This certainly sounds like the abstract idea of conservation again!

Aims of the Science Curriculum

In Section 3: The Aims of the Science Curriculum, number 5 is "a respect for the environment and a commitment to the wise use of resources (p. 11)." It goes on to state the science program should "enable students to develop an environmental ethic that incorporates:"

- an empathy with nature and its complex interactions;
- a respect for living things;
- a consideration of the effects of actions on the environment;
- an understanding of the needs and desires of human beings and how these influence environmental decisions.

Along with this specific aim directed at the environment, other aims are also met very well with this environmental field trip. The aims are to focus the development of student "attitude, skills, and knowledge" and this pond activity will help with many of them. (Note the terms "attitude, skills, and knowledge" are the same used in the Belgrade Environmental Workshop policy statement discussed earlier).

In the area of scientific process (Aim 1), students are to observe, classify, measure, communicate, gather data, analyse, conclude, explain, and generalize — all

nicely done with the aquatic study.

Skills students are to acquire for work in science and technology (Aim 2) include: facility with language, computational ability, inquiry skills, manual dexterity, receptive attitudes, and social sensitivity. All of these can be met on the field trip. Students will discuss new terms in classifying living things and doing the chemical tests. These tests also involve a new experience with manual dexterity as they try to add the ingredients of the test reagents to the water samples without losing them on the ground. Findings are used in computations to figure out what is happening with the water quality in the pond. Throughout all of this they must focus on the objective of the lab activity with some receptive attitudes for what is going on in the environment and be socially sensitive (or learn to be) as they interact with their fellow students. To make this happen the science programs must "provide opportunities for them to communicate and calculate, to engage in investigative activities, to interact with nature and the technological world, and to grapple with societal issues." What better opportunity than the pond field trip where all of these opportunities would be possible.

Other aims also touch on the environment. In Aim 4, they are to "explore local and global science-related issues." Students are also to "interpret scientific features in newspapers, magazines, journals, and books, and on television." Possibly the most prevalent scientific articles in the media concern environmental problems and a main one in Ontario is water pollution. Aim 3 has them solving problems, reaching conclusions and making decisions, "particularly at the interface between science and society." This connection is always there when dealing with the topic of water pollution and this is central in the discussion of water quality.

Aim 6, "an understanding of the nature of science as a human endeavour" is also well met by the experience of the field trip. It gives an opportunity to meet this aim because "Science depends on people working together and sharing information, not only of the knowledge that is produced but also of the processes of inquiry." This certainly seems to fit the circumstances of the pond study. Aim 6, however leaves out a very important aspect of society, the effect of human activity on the environment. Students are to be given "opportunities to understand the relationships between science and society in such areas as economics, consumerism, history, politics, law, sports, and the arts." Unlike the Belgrade principles where ecology is listed in a very similar grouping, the environment is left out of this aim even though it would integrate well with all topics mentioned.

Technology and science, and career opportunities are discussed in Aim 7, 8 and 9, including the "increasing role of computers in science." Aim 8 goes on to state: "students should learn how to operate them *(computers)* and understand their potential in scientific work." There are ample opportunities in this area available in the field study as outlined elsewhere in the study.

Student life management skills are the point of Aim 10. Students are to have an understanding of "the environment and natural resources," and "measures and dimensions," all directly dealt with in the aquatic study setting.

Last, Aim 11 deals with "a sensitivity about science and its influence on societal issues and values." Of the twelve issues listed in this aim, eight are environmental issues (population growth, origins and futures, respect for life, food and famine, biological/chemical/nuclear destruction, hazardous wastes, depletion of resources, and

environmental control) and a ninth is scientific research as would be dealt with in this field trip. This ratio shows how important an environmental topic is in the experiences of our students.

Conclusion

The development of this field trip resource for an Aquatic Ecosystem unit will be helpful in meeting the above values and purposes, goals, and aims of the science curriculum in Ontario.

We have a subject course of study, the course description, saying the aquatic ecosystem unit is compulsory to teach for this course. Here in Part 1 of the Curriculum Guideline, we have the reasons why. They relate back quite clearly to the earlier aims and objectives in the OTF Outdoor Education Manual. In the preface to this guideline (Part 1) it states that "the course descriptions include specific subject matter, while Part 1 prescribes other, complimentary components that are essential to the courses." It further stated, in italics for emphasis, that, "In designing and implementing science courses at the local level, teachers must blend the components of Part 1 with the subject matter indicated in the course descriptions." (This would be when a third generation curriculum document is made). If the benefits of outdoor education are those offered by the aims & objectives of the OTF manual, then a field trip to study a pond ecosystem is an excellent tool to "blend" the two Ministry documents together and this has been going on in Ontario since the early seventies.

CHAPTER 5:

WHY GO OUTDOORS?

Connect to the Real World

The emphasis in the Ministry documents is to have the students make connections to the real world with their academic content. That was one of the main points of the OTF Outdoor Education Manual – that outdoor experiences made these connections. The Ministry course description says you should observe a closed ecosystem set up in the classroom for a few weeks. You also must "analyse water from a nearby body of water or classroom ecosystem for abiotic factors, such as temperature, oxygen, pH, carbon dioxide and hardness," and you should "conduct a field study of a local aquatic ecosystem." The last activity best ties in with another aim of the science curriclulum, "achievement of scientific literacy" (Part 1, pg. 13). To be literate, a student must put "scientific knowledge to practical use." This activity fulfills skill objectives 2a) in the curriculum guideline, "using field and laboratory techniques to analyse water;" and 2c) "recording data from a water analysis in tabular form."

Implementing Science Technology

The pond activity connects students' lesson content with real world situations and uses appropriate technology (water test kits and/or computers: see Appendix 9 and 10) to do this. There is now more advanced equipment available. There are electronic probes to attach to computers at field sites. Some probes have memory in them,

can be left in a pond for days or weeks and can then be retrieved and attached to a computer for downloading their stored data for analysis. This technology has improved a great deal and has decreased in price so that this equipment is now in the range of secondary school budgets.

Whether you are using pH test strips to measure the acidity of your water sample or merely sticking in a probe which gives a digital read out, the students still need to know what that reading means and put it in the context of their other measurements and observations. That they are doing this with new technology just makes the experience closer to what scientists for government or industry would be doing in their professional daily activities.

Using Real World Problems

The fact that students are working on problems that are not "contrived" but that really exist should raise this activity above the normal in-class situation. Instead of analyzing data given to them by the teacher they collect "their own" data and it remains that for them. Even if the problem is to figure out the conditions existing in the pond and what that means to life there it is still a real problem. If they are looking for a suspected problem with water quality, some contamination or abnormality, then this makes the activity all the more like the job of professionals in the field.

Integrating other Subject Areas – Naturally

Three years ago there was a local Woodstock court case in the London and Woodstock papers. A developer had dug a channel to drain part of a wetland and was charged by the Ministry of Natural Resources for damaging a protected area. The local

environmental groups and the naturalist club had instigated the investigation and details were given daily. This local event, in an area that students knew personally, with people from the community that some would recognize, raised this well above any "simulation activity" any teacher could devise. It almost put the experience on the level of the field trip and in some aspects the two events, their field trip and the court case complimented and built on each other immensely. Even though this was a very blunt catastrophe – the water was just gone – dryness almost overnight – students were still thinking of a variety of possible outcomes in the area and students who did not normally talk in class joined the discussion. The situation did not have the subtlety or complexity of something like a slight temperature change over time, or a chemical change disrupting the balance in one or two factors, but it was real and right next door.

The discussion that followed had elements of economics (the developer's potential profits and construction salaries for local workers countered with the possibility of levied fines), politics and law (the laws in place and why they were there – would they be enforced?), language (the new vocabulary of the discussion and debate), geography (mapping the area to show the water flow), and group interaction as students struggled to make their views known to the class and support or attack other ideas present. Art was present from the class field trip when students had drawn some of the creatures instead of collecting and preserving them. They thus knew of some of the organisms involved when the wetland pond was drained. This experience with "art" was not seen as an art lesson because it was integrated with the total experience. The trip experience and the court case put them in a situation where they could use content and skills from different subject areas to deal with the problem. At no time did it seem

forced because they were dealing with the real world in which everything is related and nothing is in separate parts except where we humans divide it, as in schools. This integration is one of the main benefits of any field trip and this aquatic study in particular.

Group Interaction

Students work together as a team to measure and record the various water quality factors. They also must analyze the results and report in a cooperative fashion. To do this they must be able to use various social skills to work cooperatively to take the measurements and record the data. They must also catch organisms in the shallow water and identify these by recognizing certain features and matching the shapes and key features to identification sheets provided (see p. 44 for field trip forms). Later, the groups must put this information together in their analysis of the results. The result involves a variety of social skills and cooperative behaviour that come into play to a more concentrated degree than associated with their regular library research projects.

Thoughts from Established Programs

Reasons for going outdoors are summarized nicely by Michael Link when he writes from his experiences with the Northwoods Audubon Centre in Minnesota:

> Going outside does not mean that the regular classroom is not a vital center for learning. Taking a class outside means extending the school's sphere of influence. To go outside means to take learning and apply it to the playground, the woods, the lakeshore, the lawn, and the city streets.
> The outdoor world is exciting, inspiring, and constantly changing. The mysteries to be solved and the beauty to be found are complementary, not conflicting, to classroom learning.

He goes on to state:

> Outdoor education's challenge is to provide inspiration, to encourage observation, to develop ethical values, and to gain a perspective on the human role in the mechanism called Earth.
>
> Perhaps one of the greatest lessons of the outdoor classroom is this: we can learn everywhere and we can learn with and without books. We can apply what we read and we can go beyond it. Outdoor education does not fit easily into preconceived notions; it is widespread in scope and far-reaching in audience.
> No one can predict the final effectiveness of an outdoor approach to teaching. The only thing that is certain is that you will have added one more method to your teaching repertoire and the students will have encountered more stimuli than students in classes that do not go outside

(Link, 1987, p.3)

This last point is worthwhile to teachers. It gives you another teaching tool and with it the possibilities of having more successful lessons with more students. These points made by Link of the advantages of going outdoors add to the already long list from the international community, dealt with previously, of why environmental education is necessary. This type of activity, like the pond field trip, has a lot of advantages.

CHAPTER 6:

IS THIS EXPERIENTIAL?

One of the biggest proponents of doing outdoor field trips is that segment of educators that promote experiential education. These educators "hypothesize that it is best to learn about the natural environment in the natural environment. Therefore, experiential education in nature is seen as being more effective than classroom learning (Eagles & Richardson, p. 10). According to Miles, Experiential Education is the foundation of all outdoor education. To him, it is simply"learning by doing" (1990, p. 5).

This group, the experiential educators, has several areas of specialization; from the generalists to a variety of specialists. To the generalist, any form of education with direct contact to a real activity or even a pretend real activity like a simulation situation is experiential.

To the specialists of an adventure based perspective, experiential education involves long term intensive efforts in an outdoor adventure program with an apparent risk or danger element. This group has tended to come from the Outward Bound programs that have developed in the U.S. and Canada most notably in the 60's and 70's and have remained popular in the 90's with many clones offering similar programs to a wide assortment of client groups. It is now called expeditionary learning. The concept was studied to such a degree that graduate programs developed at the University of Colorado at Boulder and Mankato State College in Minnesota. The Colorado program was partnered with the Colorado Outward Bound School such that serving in the

Outward Bound programs at that school as a staff member or observer were required parts of the degree. The Minnesota college, which did not have as high a reputation as a research outlet as the western program, would give credit to experiences at the Minnesota Outward Bound School outside Ely, Minnesota, as long as tuition fees were paid for those credits. These programs had the narrower title of Masters of Experiential Education as opposed to the broader term, Outdoor or Environmental Education, which the graduate programs at schools like the universities of Illinois and Michigan used.

Other conflicts abound in discussions of experiential education. Miles (p.6) recommends students use field guides to explain what they are seeing and hearing — their use will "enhance" their experience. Gough (1990, p. 12), discusses the act of naming or categorizing in science as being bad for us culturally. Naming parts of nature helps make humans appear seperate from nature or the environment. "Assigning a name to something constructs the illusion that what has been named is genuinely distinguishable from all else. In creating these distinctions, humans can all too easily lose sight of the seamlessness of that which is signified by their words or actions (Gough, p. 17)." This second position can lead to a discussion of "deep ecology", a rather heavy philosophical burden for a grade 11 general class. Fortunately, we must simply follow the Ministry guidelines and save this discussion area for that special group of students, perhaps an Outers' Club on their second or third night out in Algonquin Park with nature in spring bursting out around them.

The question develops – is the pond study field trip really experiential, thus carrying with it the benefits as portrayed of experiential learning?

Some educators support any activity where students are doing activities with their hands as being experiential. Others put it outside the classroom into the real world, or any activity that gets students into a heightened involvement as being experiential. The pond field trip does meet any criteria used to categorize an experiential learning situation, other than those requiring the heightened awareness to come from a high risk activity.

Chapman et al. discusses many important points and criteria about the experiential method. This makes it even more convincing the pond "experience" qualifies. According to Bill Proudman in his section of the article, the Methodology of Experiential Education involves the following ten points (p. 21):

1. Mixture of Content & Process
2. Absence of Excessive Teacher Control
3. Engaged in Purposeful Endeavors
4. Encouraging a Large Perspective
5. Multiple Learning Styles
6. Reflection
7. Creates Emotional Investment
8. Re-Examines Values
9. Meaningful Relationships
10. Learn Outside Perceived Comfort Zone

The pond study field trip involves most, if not all of these ten points. It does use a mixture of content and process in that students are testing (process) the water quality parameters and are using these results to summarize the conditions in the pond (more process). There is an absence of excessive teacher control since the students are involved in groups assigned to do a portion of the total tests. The teacher is there to help them with any problems (not give answers but offer guidance) and to be a safety factor since they are near and sometimes in a body of water. Students are engaged in purposeful endeavour since they have been assigned certain tasks and

must complete these in the assigned time so they can later continue with their analysis. The analysis is for the overall water quality of this pond, a larger perspective then they would normally consider in their school day. They need to carry this ability to analyze any body of water in different situations so this broader perspective will stay with them throughout their lives as responsible citizens. It is very easy to move beyond one learning style to multiple learning styles since the students and teacher are out of the classroom's four walls and thus have no blackboards nor audio visual equipment to rely on for any presentations. Students will be talking together more, will talk to the teacher on a more direct level about problems the students have recognized, not those imposed by the teacher. They will be making their own decisions as to the timing of events and equipment to use and their own actions. If a test does not make sense to them from what they have already observed, they will have to make the decision of doing the test over again.

There could and should be time taken for reflection after the exercise/experience. Some schools like the Outward Bound programs encourage a journal be kept detailing their experience and feelings during the program. This formalizes slightly the reflection process and groups then make sure it is done by having a group debriefing sessions periodically through the program and a major summary session at the end. Most often there has been evidence students' doing their own reflections after the pond field trip experience. The next day before the class starts, students will make comments about the experience or ask questions about it. It is obvious they have been thinking/reflecting about it. Their questions and comments have required a "reflective" discussion of the event whether or not that was scheduled by the teacher at that par-

ticular time or not. This is important, for as Miles states (p. 7):

> The outdoor educator must place the wilderness experience in context for students, prepare them for their encounter with nature, and then transfer the lessons learned in that encounter back to the students' home environment. This is common sense, yet all too few outdoor education programs have adequate pre- and post-field activities. The principle of continuity requires such effort if the outdoor experience is to be more than a pleasant interlude from the rigors of the classroom. Meaningful transfer after the outdoor experience can be achieved and must be achieved if the investment the experience is to be justified.

Students appear to have an emotional investment in the field trip since they appear much more excited and involved than during some other class activities. They will show each other the organisms they have caught and make appreciative comments about the organisms or "critters" as they often end up being called. They will also ask each other about the test results to double check their findings with those of other groups and they will discuss their data among themselves. These are actions usually lacking when they have little interest or investment in the activities, leaving them to announce their social plans across the classroom, activities they do hold dear.

Seeing the variety of organisms present in the water and the special adaptations some of them exhibit makes them see different creatures from a new angle. Comments like, "I didn't know all those different things existed," are quite common. Some students will talk to others and make sure the others are treating the creatures carefully and are returning them to the pond. This can be seen as re-examining their values since the creatures they never knew existed are now being cared for by them. They see the body of water in a new light, not just as a reflective pond, perhaps a pretty view, if they noticed it at all, but as a home for lots of different creatures they never knew were there.

Meaningful relationships are easier to develop and recognize in the outdoor experience. There is a different relationship between the learner and the teacher now that they are outside the classroom. The student or learner can be more aware of their own relationship in the learning process. Students, even if they at first appeared to intend to stay out of it, usually participate in some part of the field trip activities. This has held true even if they traditionally stayed out of any activities in the classroom. They are also "in the environment" and the relationship between it and them, the learner, is much more apparent than in a classroom situation where people talk about, read about, write about, or view a video about the environment. These relationships are there and they mean something to the learner.

Another way that the trip experience can both be meaningful and have carry over value after the trip itself is in students' contact with the media. There should be a fair amount of influence from society at this time in the world to become involved and knowledgeable in areas of environmental education. Aside from articles on politics at various levels, be it local, provincial, national or international, environmental issues are most frequently seen in the media coverage. They may be linked with science and technology, or the handling of an environmental issued by a political party, usually the government, or how a business is messing up the environment in some way, or even how schools are dealing with certain environmental issues. This area of the educational curriculum — the environment — is in newspapers and on television all the time. Surely this influence or presence could be tapped to get students "engaged" in this subject or activity? This engagement is one important aspect of experiential education. It comes from the students actively participating and understanding how relevant is the

issue (Chapman, p.17).

If it rains as it did on our pond field trip, or if the mosquitoes are biting as they were on the second trip, students are operating in a learning situation outside their perceived comfort zone. They may not like working in a group nor with the group they are in, now with the stress of analyzing this unknown situation, the quality of the pond, so they are outside their comfort zone on an emotional and an intellectual level as well.

So, yes, this pond field trip is experiential.

CHAPTER 7:

AQUATIC STUDY FIELD TRIP

Trip Description

Students from Environmental Science SEN3G1 travelled to the Oxford County Board of Education Outdoor Education Centre on June 13, 1994.

The centre is run by Brian Grigg, a new member of the boards instructional staff who has worked in programs at three other environmental centres in the province. His main experience is with elementary students as these are the students the centres receive as visitors more often.

Because of the heavy load on elementary programming at the centre, my class would do the study without Brian's full assistance, although he was available for planning and choosing the best areas to conduct the study. Brian also left the students collecting nets with long handles. Other equipment was provided by us.

This time period is one of two afternoon classes. It had been planned to schedule a full afternoon at the centre with them which would mean they would miss their other afternoon class. We had done this for a forestry/wildlife visit in February. Because this was the last unit of the year and we were close to the June exam period, it was not possible to take them for a double period and have them miss the other class (an administration ruling). We chose a day with their class last so that we could leave at the start of the ten minute break between periods and not have another class to rush back to after this class. In this way I had expected to be there untill about four p.m. and

the students had agreed.

The classes final complement was 19 students, but on the day of the field trip there were only 10 in attendance. It was the Monday of the last week of classes. Two dollars had been collected from the students. From this collection and their comments, I had expected to lose about 3 students for the study, not 9.

The centre is about fifteen minutes away by school bus. The board subsidizes the bus for Oxford County schools so that the cost to the class is $54.

Buses often have to pick up students for return runs from the high school at the end of the day, so, even though I had requested a bus that could stay longer at the outdoor education centre, I was informed by the driver when we arrived that she had to make her normal run after school and we were stuck with having to leave by 3:30 pm to return to school. This did not bother us in this instance because by the time the bus did arrive for our pickup, it had been raining quite hard for half an hour and students had lost interest in the collecting activity.

The pond is directly behind the old schoolhouse that serves as the centres' classroom and storage area. It is almost entirely enclosed by trees on the west side and more open on the east side but very grown in there with cattails and other wetland plant species. The bottom is soft mud with several old stumps showing in the end near the schoolhouse. Water depth is about two feet throughout. The pond measures approximately 40 metres across from east to west and 150 metres from north to south.

The class had been given sheets of instructions and identification guides to organisms (see p. 41 - 47), most of which had been dealt with early in preparatory classes. The information on the sheets (pond note, p. 41 and Chemical Factors of

Water, p. 42) were to aid the students in their analysis at the pond location.

At the most open gap in the trees at the waters edge on the west side we started the activity. There were several logs floating in the water in this open area and water plants along both sides. No students had remembered to bring rubber boots. The other alternative was to wear old running shoes and wade into the water in them. Several did that, and several made the vain attempt to keep dry along shore and still try to help out with the testing. There was a lot of mud in the water and up on shore since no grass grew under the trees. Students were to do chemical tests for dissolved oxygen and carbon dioxide in the water as well as pH and water temperature and air temperature. In addition to the chemical tests, they were to collect water samples with plastic containers and identify aquatic organisms they found. As well, they had long handled dip nets to search for organisms.

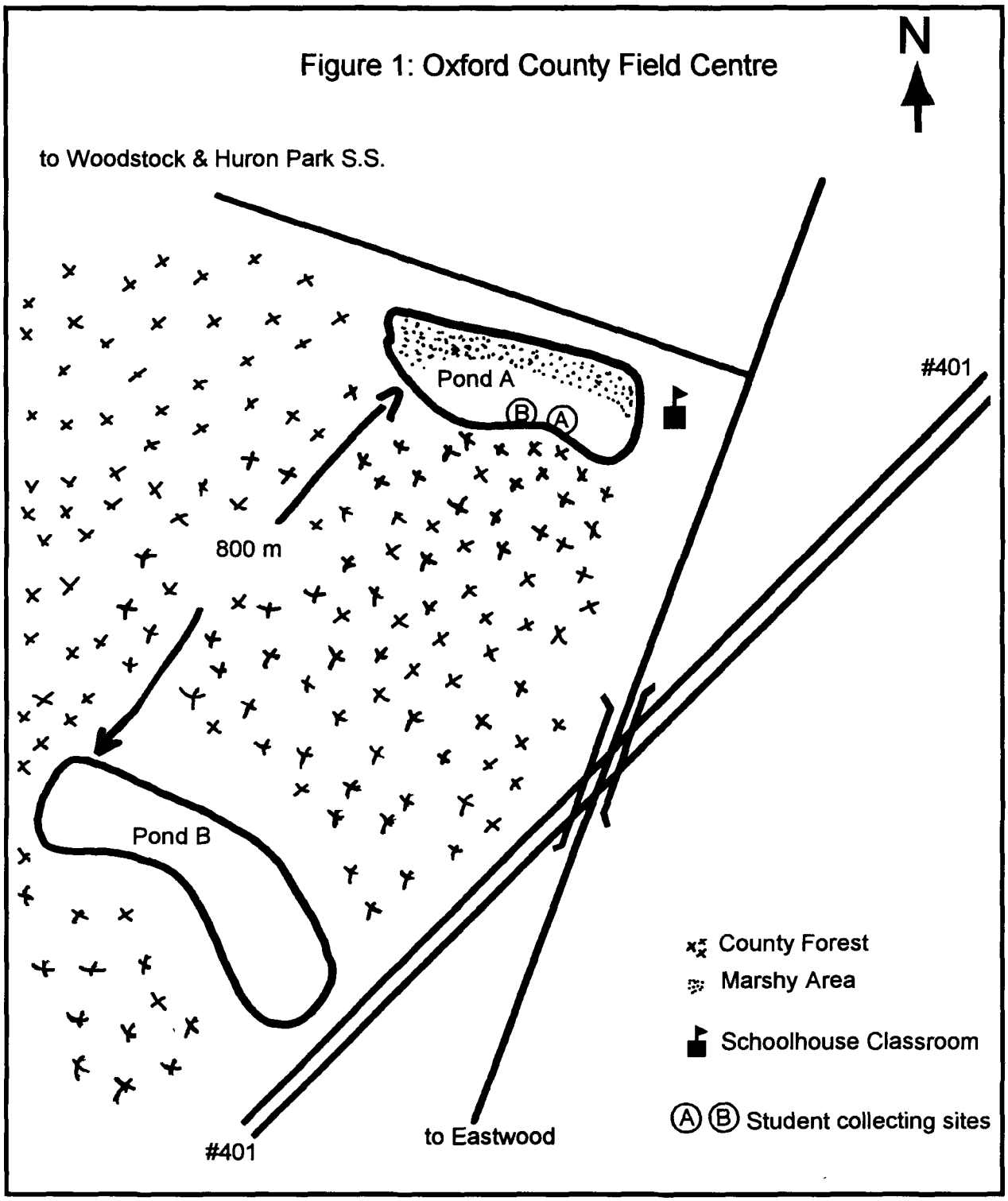


Figure 1: Oxford County Field Centre
N
to Woodstock & Huron Park S.S.
Pond A
B
A
#401
800 m
Pond B
County Forest
Marshy Area
Schoolhouse Classroom
A B Student collecting sites
#401
to Eastwood

Figure 2: What is a Pond?

Background information to keep in mind!

Are both made by human activity and occur naturally.

A shallow body of freshwater with very limited circulation

Shallow - Light can reach bottom depending on clarity of water

- Deep enough that it does not freeze all the way to the bottom.

Has distinct layers & areas where specialized organisms can live.

Provides homes for permanent residents and seasonal migrants.

Quite similar species in different parts of the world.

In total, comprise a fairly large area of fresh water on the earth.

Over Time:

Will fill in briefly (50 - 100 yr.) depending on nutrient levels. It will fill in with organic matter.

eg. Beaver Ponds become Beaver Meadows.

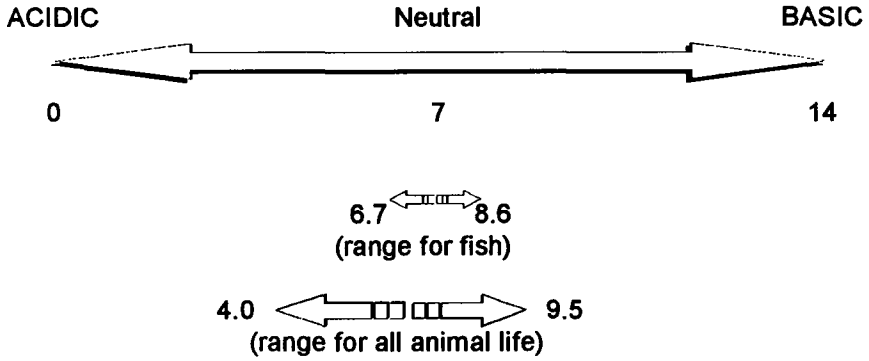
Self Perpetuating: Most resources recycle.

Figure 3: Chemical Factors of Water

1. **Oxygen** — temperature dependent variable. As water temperature increases, the solubility of oxygen decreases.
   - 0-5 ppm poor water quality
   - 5 ppm marginal
   - 5-10 ppm good levels

2. **Carbon Dioxide** — several possibilities can affect this factor
   - — 5-10 ppm are normal levels
   - — above 10 ppm abnormally high levels

3. **pH** — The level of acidity of the water (measured by the % of hydrogen ion)



4. **Alkalinity** — the ability of the water to neutralize acids, ie.) a measure of the relative concentration of the bases HCO and CO
   - 50 ppm Minimum levels
   - 150 ppm good levels
   - 250-300 ppm excessive levels

5. **Hardness** — the levels of dissolved Calcium and Magnesium in the water
   - 0-59 ppm soft water
   - 60-119 ppm moderately hard
   - 120-179 ppm hard
   - 180 up ppm very hard

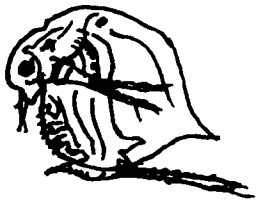
6. **Nitrate** — an essential growth compound of aquatic plant life, used very quickly by the plants, therefore high levels are not found in the water tested
   - 0.3 ppm Nitrate gives the potential for an algal bloom

7. **Ammonia** — this is a product of the decay of dead organic matter and is a nitrogen compound that will be converted by the action of bacteria to the usable form — Nitrate

8. **Phosphate** — an essential grown compound of aquatic plant life, it is often the limiting factor to growth in most aquatic ecosystems.
   - 0.015 ppm Phosphate is all that is required to give the potential for an algal bloom

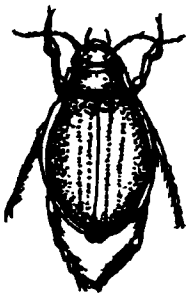
Figure 4:

Identification Guide to Aquatic Pond Organisms



Daphnia

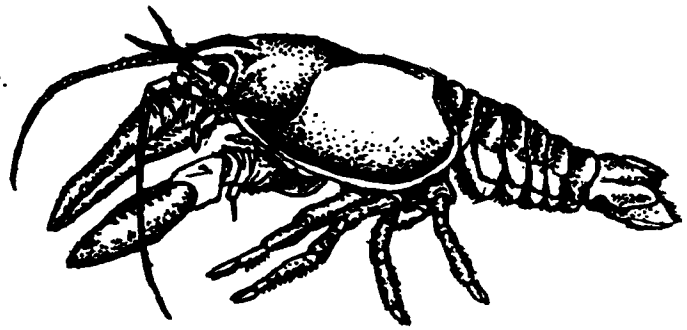
Developed for use in classifying and identifying organisms at the Oxford County Field Studies Centre.



Dytiscus

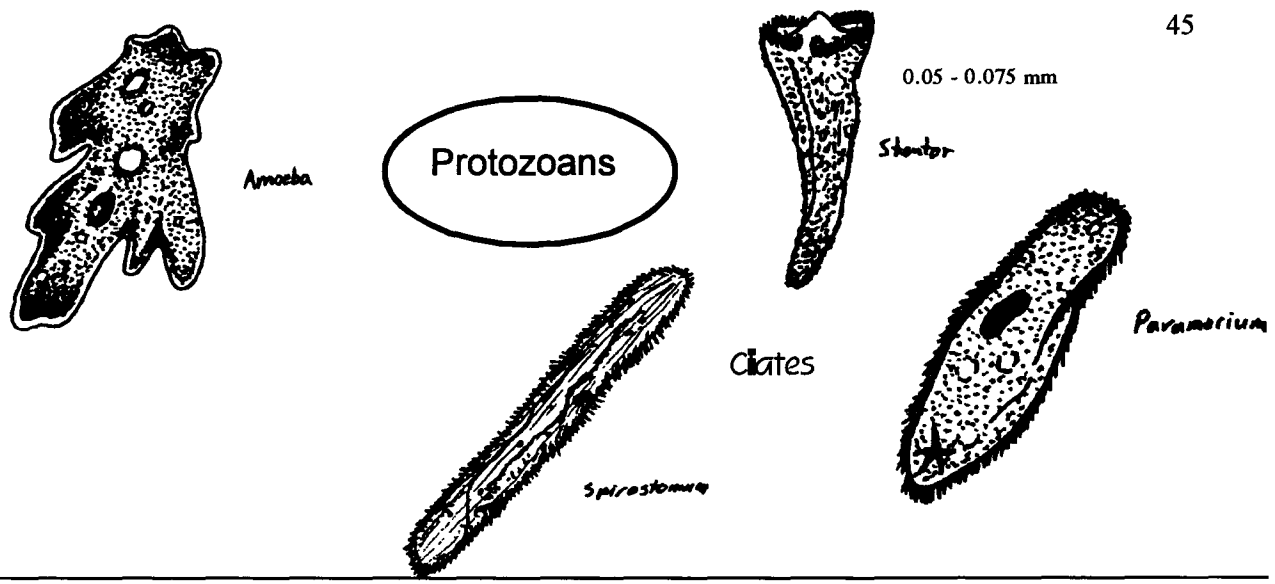
Giant water bug

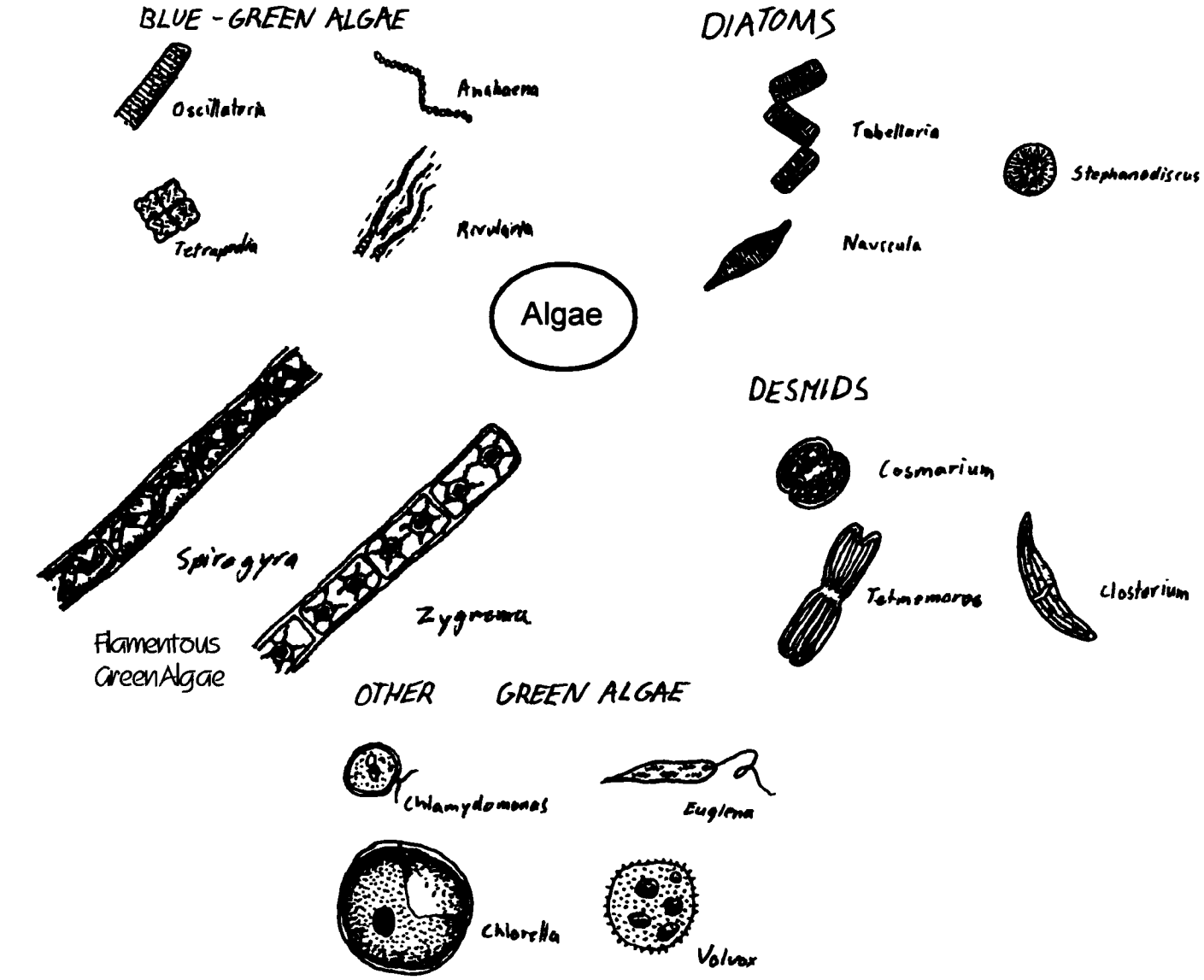
Sizes are given below the diagram. Where no size is shown, the drawing is life size.



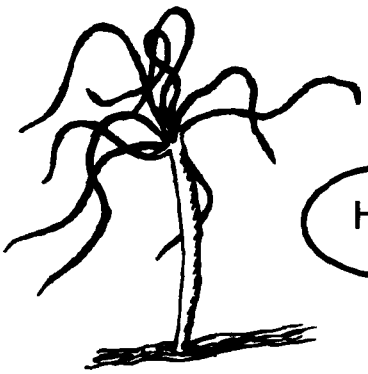
Crayfish

Prepared by: Bill Thompson, Oxford Ct. Bd. of Educ.
Drawings by Mike Bond, Huron Park S.S.

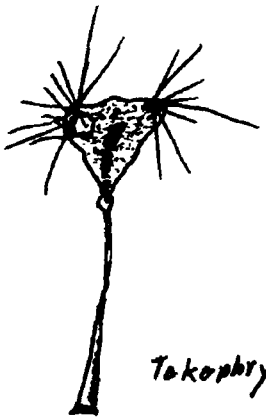

Protozoans
Amoeba
0.05 - 0.075 mm
Stentor
Ciates
Paramecium
Spirostomum


BLUE - GREEN ALGAE
Oscillatoria
Anabaena
Tetraspora
Rivularia
DIATOMS
Tabellaria
Stephanodiscus
Navicula
Algae
DESMIDS
Cosmarium
Tetmemorus
Closterium
Spirogyra
Zygnema
Filamentous
GreenAlgae
OTHER GREEN ALGAE
Chlamydomonas
Euglena
Chlorella
Volvox

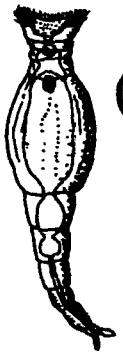
Colpoda



Hydra



Tokophrya

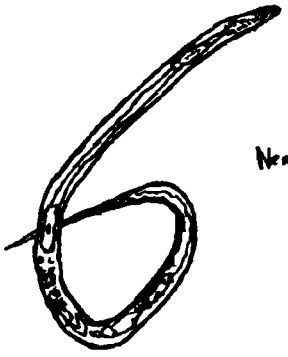


Rotifer

0.1 - 0.15 mm

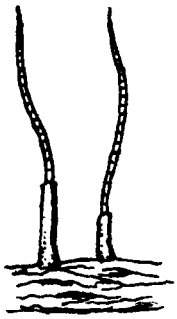
Worms

leech



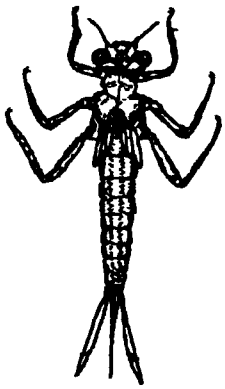
Nematode

Planarian

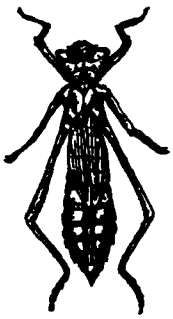


Tubifex

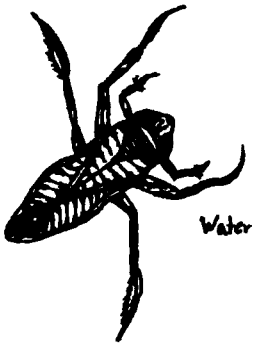
Insects



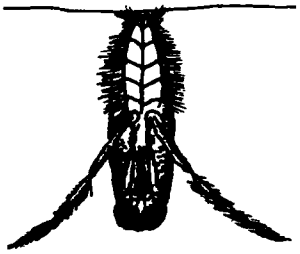
Damselfly



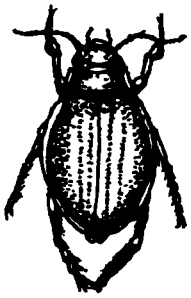
Dragonfly nymph



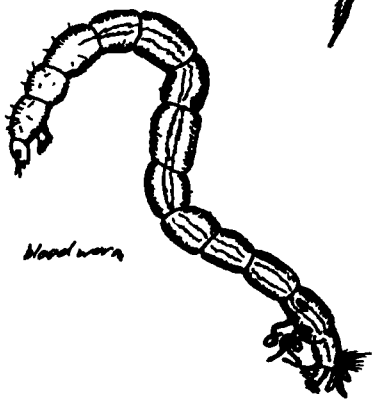
Water boatman



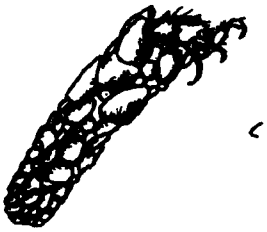
Backswimmer



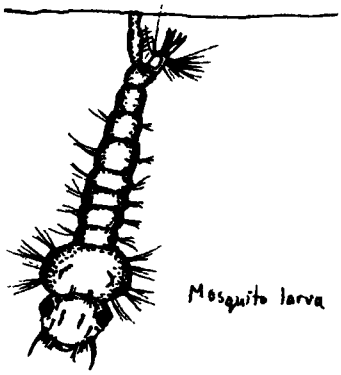
Dytiscus



Bloodworm



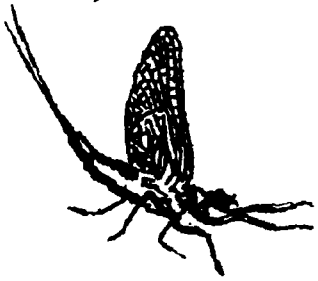
caddisfly larvae



Mosquito larva

Gyrinus

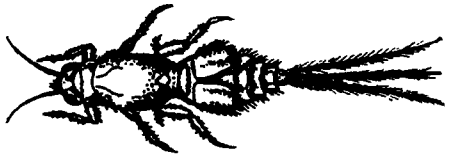
Adult Mayfly

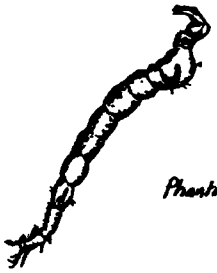


Mosquito pupa

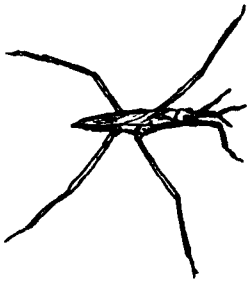
Whirligig beetle Larva

Mayfly nymph

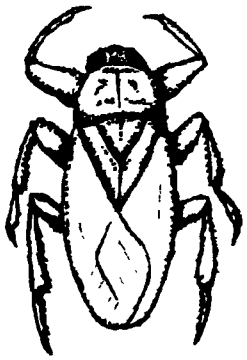




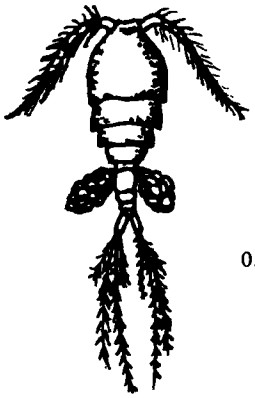
Phantom midge larva



water strider



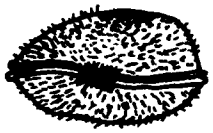
Giant water bug



Crustaceans

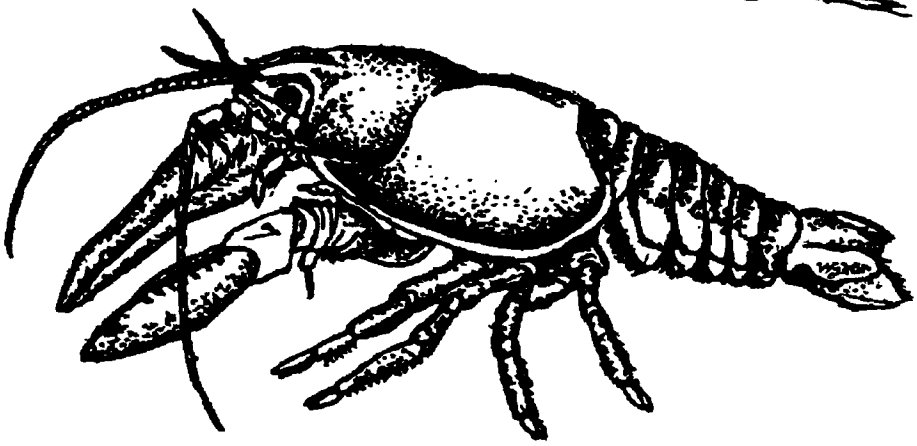
Cyclops

0.5 - 1.5 mm



Ostracods

Daphnia



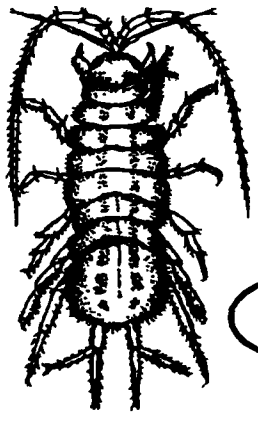
Crayfish

fairy shrimp

Sideswimmer

amphipod

Aquatic Sow Bug



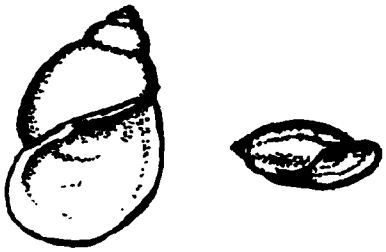
Amphipod

Molluscs

Snails

Asellus

Isopod



CHAPTER 8:

EVALUATION OF THE AQUATIC STUDY FIELD TRIP

Background

The outdoor education centre in Oxford County has an opportunity for program changes in that there is a new staff member there, Brian Grigg, to plan and teach and help bring in fresh ideas. With his support, the field trip with my students was set up. The intent was that any program ideas and materials would be distributed throughout the board and used as advertising for other teachers to offer a similar study for their students, and have materials, documentation and activities, for their students to use. In order to show that the activities and methods were effective and worthwhile, an evaluation procedure would have to be worked out that could be easily duplicated and provide relevant data supporting the program (or not as the case may be).

Evaluation is a means to "find a niche for environmental education in the curriculum" and a way to "convince the educational community that environmental education can improve the curriculum and make it more relevant to students" (Bennett, 1989, p. 14). Flor (1991) puts this in slightly different terms with a practical application when he discusses the "marketing" of experiential education (of which some aspects of environmental education are a part). "There is a need to attract participants in addition to convincing funding agencies (the board) and administrators of the benefits of integrating experiential education into their programs" (p. 38).

The above is similar to the discussion in Kemmis & Stake concerning evalua-

tion and its link to power (1993, p. 53, 86), a topic also discussed by Hamilton (Kemmis & Stake, p. 102). Evaluation methods give you data that shows whether or not your educational presentation or method has validity. Does it work to do the job for which it was intended? If experiential or outdoor education is effective in accomplishing certain educational goals, then this is a strong reason to use it in the system. The argument then has "power".

For this report, the students' reactions and improving the program to give students a better background and skills base to better understand and pursue an issue, will be the central focus of the work.

Research Design

The evaluation followed two paths, one with Huron Park students themselves and one with educators from other outdoor education centres where water studies are done. No testing or evaluation was done for this study using students from other centres.

The evaluation of the student experience followed a pre-post-test design for formative and summative evaluation (Bennett, p.17). The intent of this method is to gauge the students' experience as it pertains to the objectives of the set curriculum.

Other centres were chosen that were close in program structure, length of program and their nearby location. They were also chosen because of the long duration (history) of the program and thus the long experience of the instructors. The intent was to gather ideas that would work most effectively at the Oxford site because the other centres had found the most effective methods.

There are other programs that have occurred in the province, such as East

York's summer environmental science credit for advanced students — a program offered in the past by Dennis Hitchmough of that board. Having spoken to Mr. Hitchmough in the distant past about this program, known as beeing interesting and very successful it was decided there were too many differences to warrant its comparison to Oxford County's program. Students were volunteering and paying for an extra credit at the advanced level during the summer holidays. The residence situation was over an extended period, or, if for daily periods only, still lasted over a prolonged period, well past the one day and one or two period possible in Woodstock. Their pond was a much larger and much deeper body of water, which made necessary the use of boats and safety devices (life jackets) to do tests, which we were not doing. They were dropping a sechi disk from the boat to test the water turbidity or clarity. Our water was either clear or totally opaque depending on whether or not someone had stepped into the shallow water along the shore and stirred up the fragile and ever present mud bottom.

Other centres such as the Scarborough Outdoor School near Huntsville and the Leslie Frost Centre near Dorset are on shield country where the environmental factors are different, as are the travel times for classes, necessitating longer stays in the area and resulting in a different experience, including higher cost. Thus, these programs were also left out of the survey of other centres.

Discussions with educators from other outdoor centres to gather program and evaluation methods began with informal conversation interviews, later becoming more structured as details of their programs allowed for comparisons of methods and equipment. This soon developed into Patton's general interview guide approach with a

series of topics outlined for discussion but with no constraints involving order or other conversations occurring (Patton, 1980, p.197-198). By finding out strategies used by other centres to make the experience a positive one for students, some of the trial and error of developing a new unit could be avoided.

As well, observations of students were made at our site, notes made to summarize these observations, and then a debriefing session held with students to discuss their opinions of the event — again the conversational interview approach. Discussion of these methods is in later sections on the "Evaluation Critique" and the "Revisions for Future Field Trips", while the forms and interview write-ups are in the appendices (1 - 6).

There were problems in making the study scientifically and statistically significant. Unfortunately, the field trip occurred in the last unit taught in the year. Units taught here at the year-end have little time flexibility and the options before final exams to leave the school, even during class time are extremely limited. The outdoor education centre was crowded with elementary classes leaving the centre's instructor largely unavailable to us. All this was compounded by the attendance problems in this senior class at the end of the year. The decision had to be made to run this evaluation as a pilot to test the unit, the field trip, and the evaluation methods. These environmental classes are run alternately, grade 11 one year, grade 12 the next, so it was to be a full year before another class was available — unfortunately with the same grade 11 student attendance problems. This has forced the project to be an exercise in trying out the materials and methods without the subject numbers base to validate results statistically — again, a pilot only. With the low numbers of students involved, perhaps

repetition of the study over time will allow some interpretation of the data.

Observations

Student groups had two main tasks — The first was to check the physical/ chemical components of the pond water such as temperature, acidity (pH), dissolved oxygen (O_2), dissolved carbon dioxide (CO_2), nitrates, ammonia, alkalinity, hardness and phosphate level. The second task was to collect and identify any life forms present in the water or sediments, keeping records of organism types and numbers and returning the creatures safely to the water.

The follow up to this was to tabulate the data – the physical components of the water quality and the numbers of various aquatic species, both plants and animals. From this – an evaluation of the chemical quality of the water can be made which is cross referenced with the biotic situation that is present. The form used to do this last part is Beek's Biotic Potential, a form students fill in according to categories of organisms and their numbers. To do this they must be able to identify and classify some of the pond organisms from simple (shape) identification sheets. Basically, it comes down to the fact that more types of organisms are better than fewer and some types live in better water quality then others. The first part leads directly into a discussion of biodiversity – a topic that you can follow up in several large issue discussions such as the clearing of tropical rain forest or over harvesting the ocean.

Identification sheets similar to the revised sheets on pages 44 - 48, which were used with permission from Wrigley Corners Outdoor Education Centre, appeared easy to use and durable (they were laminated). Some guidance was needed in clarifying between organisms of similar shapes. Students appeared weak in categorizing

organisms into proper niches (their jobs or roles) in the ecosystem. It is very hard to fit enough time into this unit to better prepare for this identification exercise. There are only eleven or twelve seventy minute classes for an entire unit if you have no classes cancelled with other school activities. This is not adequate time. A way to improve the recognition skills of the students would be to purchase samples of aquatic organisms from science supply companies to practice with before the trip.

Questionnaires & Interviews

a) Student Questionnaires

Both pretests and post-tests (see appendix 4) were taken from the package put together at Wrigley Corners (Quantz, 1994). This is encouraged by several authors such as Sudman (1983, p.14) and Converse (1986, p.50). They can save time, be used as test questions (if they still fit the situation), and can be modified to bring them into line with the current questionnaire. Questions are closed with choice of answers specified on the page. The questionnaires start with knowledge questions and proceed to attitudinal questions as advised by several authors including Sudman (p.101). The "aided recall" format with answers to be chosen already on the page is easier than having to recall the answers from memory (Sudman, p.101).

Because of the low number of students taking the tests it is hard to see trends in the data. Also, because this was the last unit of the semester and terms in ecology were taught in two other units, there should be some carry-over with both knowledge and attitudinal questions.

Knowledge is weak in both pre and post-tests concerning the abundance of organisms, whether they are herbivore, carnivore, omnivores or scavengers (Appendix

2: question 3 of pretest, 5 of post-test). Naming organisms checks this knowledge as does asking what group the organism belongs in (question 1 of pretest, question 7 of post test) or asking which examples of these organism categories is most numerous (question 4 pretest and post). Perhaps not enough organisms are found to see any patterns develop or perhaps there is not enough time spent reviewing this material.

Other areas such as knowledge of plants (question 6 of pretest, 3 of post-test) were almost 100% correct. Many of these students have taken other environmental courses or possibly horticulture before this course, as well as the other ecology related units earlier in this semester. These would have been without a major field trip component away from the school yard.

The attitudinal questions (6-10 in the pretest, 1,2, 8-10 in the post-test) are all answered correctly, that is, they all showed concern for the well being of living things. This does not coincide with some observations at the pond of some students dumping pond water and with organisms up on shore. To check on the students' respect for living things and to look closer at the groups' cooperation, a group evaluation form will be used in the future (Appendix 5: questions 3,5,7 for respect for life questions).

The student questionnaire (Appendix 6) to finish the unit showed several definite trends. Students generally thought the unit and field trip worthwhile but felt that not enough time to explain things ahead of time (question 3) was given nor was enough time given at the pond for collecting and identification (question 4). Some parts such as question 5 and 11 leave doubt as to the adequacy of the equipment and tests.

The Unit Evaluation:	**Low 1**	**2**	**3**	**4**	**5 High**
5. The tests were easy and understandable?	**(2)**		**(1)**	**(1)**	**(2)**
11. Equipment was adequate for the activity?	**(1)**	**(1)**	**(1)**	**(2)**	**(1)**

This was perhaps because groups of three or four students to one test or net left some students not working. There were enough test kits that two people could have been testing per group, but not with the favoured Hach kits, which most centres prefer. A surprising point is that students all said the cost to them should be higher than the $2 charged. Some students wanted longer time at the centre and they obviously were willing to pay more to ensure that they had more time. The end of the questionnaire is open to allow more descriptive comments to come out.

18. What improvements/recommendations do you have for the unit?

- **It didn't have to rain, but that's not your fault and it would of been nice to have gone a whole day to bonfire for lunch/walk on nature trail and tests ect. using the microscopes.**
- **Revamp the O_2 test kits. Need more sulphide powder. More time at Outdoor Ed. Centre**
- **I think in the future you should charge around $5, but have a whole day to do the study to explain yourself more.**
- **Should have covered more in class first.**
- **Go over it and other units faster with way fewer interruptions.**

19. Other comments:

- **General it was pretty good.**
- **Idea & concept is great. We need more time & preparation though.**
- **Good overall unit except for mosquitos.**

b) Staff Interviews – Other Centres

Interviews with staff from other centres provided a fairly standard view of the unit and techniques used throughout. In terms of evaluation though, only Waterloo Country had an ongoing evaluation process at work to check on learning objectives of students in their programs. Most centres did not even check to see if teachers were doing preparatory work ahead of their visit, nor follow-up to see if sessions after the visit (debriefings) had been done to formalize the students' experience in any kind of organized way. Wrigley's Corners, operated by Ken Quanz and Ted Cheskey, did both

(Quantz).

In terms of qualitative data, test kits preferred by almost all centres and teachers were the Hach kits. Only one teacher spoke up for Lamotte as an equal choice but still said Hach were very easy for students to use. Tests covered by all centres were: temperature, pH, dissolved oxygen and carbon dioxide, nitrates and ammonia, as well as surveys of organisms present. These tests are all standard at all centres and are listed in the Ministry course document.

Time spent at the water site was generally one to two hours. It was interesting to note that all centres agreed on the need to stay out of the muddy areas in order to prevent harming the sited in the physical sense of an erosion problem but also for the problem that the habitat for the organisms would be destroyed. This would quickly have a negative effect on the organisms present and affect the results of the biological surveys. Ironically, the only sites open to study at the pond at the outdoor centre in Oxford Country are very muddy, both in the shallow pond bottom and the shore entry points, which cause a muddy runoff into the pond water. Most centres also all collected the test samples to dispose of the waste chemicals at proper disposal areas in schools. These are all factors fairly close to the situation to be used in Oxford County.

All centres agreed that staying out of deeper water was a safety priority and some, including the Boyne River Natural Science School near Shelburne, had prepared a grassy area that both prevented erosion and channeled students to this safer area where the entry was gradual and shallow. The Woodstock site is not very deep but is a very broad area and hard to set boundaries, especially for certain male students. During the lab activity, two male students, alternating their time in chest waders,

got out so far they could not be called back easily (also evidence of their enthusiasm for the activity). They had numerous tree stumps to grab onto and rest on in the water which had a maximum depth in this area of 1 meter (this was the general depth overall in the pond). The predicament that did provide some light entertainment for the rest of the class was their becoming stuck for some time in the bottom mud, the suction was so strong.

The avoidance of deep water because boats must be used for sampling, in all schools mentioned, showed one of the main reasons for not including the summer credit program of the East York Board of Education – they do use boats to test in deep water. The new complications and safety factors this adds to the activity are just too much for staff to cover adequately in the short program the Ministry unit requires.

There was disagreement on which test items students found to be the most positive and enjoyable. Some centres opted for doing the chemical tests first so students could see a colour change right away and feel they were getting results. Other centres said their students found the living organisms most interesting so they stayed with this aspect as an interest arouser. Pine River uses rubber boots while collecting samples (Royal, 1994), but the Boyne River Natural Science School does not, saying students enter deeper in the water, then tend to flood the boots with water making them a danger for a potential drowning. (Fallis, 1994).

All Centres, save London, do their work from a grassy shore with the aid of small dock areas to make access easier. They really do not have an access problem. The water testing component is a key element of their program and needs to be set up efficiently and safely. London has a dock set up which gives excellent viewing and

collecting access with little disturbance of the pond ecosystem (Read, 1994).

To return to the chemical tests but from an interpretive stand point, the staff of all centres said they went beyond the translation of chemical test results to the connection of results with ecological diversity, the main emphasis in the curriculum objectives. This is one of the most important points of the entire unit – to interpret the results of water quality tests. When is it good water and why? – Students need to be able to judge this and explain their decisions – and all centres appear to have this as their ultimate goal.

Evaluation Critique

Although informal observation is used at the study site during the Huron Park students' field trip, it is hard to say these observations are detailed since the observations were made while teaching, dealing with the students – a double duty. The point is, the only source of any class/student observations on this field trip was by the teacher in charge.

Still, any teaching or interaction with a class of students is done with the aid of continual observation. An effective teacher should be a good observer. It is hard to comply with Patton's suggestions, or rather orders, to take notes, notes and more notes. You have to watch during the activities and write as soon as you get a chance. Since Patton was an outside evaluator and not the classroom teacher, while this trip only had the lesson teacher, this is a weak area in the evaluation process. It is still one with which most teachers are left — they must face the situation alone. An answer to this would be to have an assistant along to handle the teaching mechanics for you. Since it is already difficult to find coverage in your school for any classes you might

have to leave behind working with a standby teacher, another answer might be to bring along a more senior student from that helpful environmental chemistry class with which you could be working. Lacking that, to make this observation method more time efficient yet help retain ideas for later, you could jot down key words as reminders of any incidents and observations.

Trends in the data are hard to see because of the low number of students taking the tests. Also, because this was the last unit of the semester and terms in ecology were taught in two other units, there should be some carry-over with both knowledge and attitudinal questions. This probably resulted in the high scores in the knowledge areas. Having the knowledge test before any unit dealing with these key terms could nullify any advantage here.

The student tests do have a component for measuring attitudes and values, but it is rather direct and shallow. For example, question 8 in appendix 2: "What would you as a farmer do with a wetland/pond area on your property?" The answers are very slanted as either being opposed to a wetland, "fill it in," or for the wetland, "leave it alone," in the middle of your field. In a school like Huron Park with a rural population, it is very clearly a choice with a definite economic penalty – the loss of income for the farmer. The alternative, abstract concepts of conservation or biodiversity are difficult concepts and on a different philosophical level then "money." Perhaps a discussion of the activities of "Ducks Unlimited" would be useful here. This organization does appear to tie in these two contradictory components of conservation, not using the land but saving it for the use of wildlife, and still receiving a financial return for agricultural property.

An attempt to hide the attitude and values oriented questions is made in mixing the question order, but in ten questions how much can be hidden? By mixing the questions, an attitude question comes first in the post-test, which is not generally considered to be good order (Sudman, p.101).

An unobtrusive way of measuring attitudes is being on hand to see what students do with water samples the collect – do they return them safely to the pond or merely dump them on shore. When finding creatures , do they chase them – frogs for instance, and do they pull up plants in search of animal life. They could also be observed for environmental comments such as "look at the mess we made in the water."

The post-test had a weakness in the instructions leaving one student who did not see the questions on the back of the page. The form does not advise the writer to turn it over. This has been revised to one side only for the future but there may be a need for a mixture of open questions after the closed first reply (Converse, p.15). It would give more room for explanation and more freedom of response. Converse explains that she asks "why?" as an open question. Oppenheim also asks "why?" and "why not?" (Oppenheim, 1992, p.111), a method which will add much more flexibility to student responses.

Some of the responsive questions need to be arranged vertically (Birdie, 1974, p.46).

All of the above are points in making the form clearer to read and more attractive in presentation. A two-page questionnaire would still be brief but have more room to gather data and impressions, and a form that would obviously be two-sided. It would still need to be clarified with the statement "continued on back,' to make sure there are

no mistakes.

Questions in the two tests seemed to have fairly good flow and not be too abrupt in their changes. But the topic was not that large to diverge in the questions.

These tests are not student centred but focus on the curriculum objectives (Kemmis, p. 63). As such, they are criterial, with pre and post-tests dealing with knowledge of terms set out in the objectives or dealing with set attitudinal objectives. Thus, they are also comparative (Kemmis, p. 56-60). It is still criterial if "informed judgment" is used as in the method using teacher observations. The curriculum gives the objectives to judge the student against rather than deal with quantified measurement (Kemmis, p.61-62).

Other Centres, Other Teachers

The interviewing technique used to discuss the programs at other outdoor centres is called "semi-structured" type (Kolb, 1991, p.41). It gives flexibility in pursuing topics of interest. It is also not so structured as to be rigid and ruin the "two-way flow of communication" (Patton, p.241). Not mentioned on the interview question sheet (Appendix 3) is the fact that the purpose and use of the interview is outlined at the start, generally at the first contact when permission is asked to meet for discussion. Patton feels this is very important (1980, p.241) but it is hard to think of how you could have an interview or any discussion with someone, without telling them what it is about and what your interest is in the subject. The purpose was explained at the start of this aquatic study unit. It seemed to add an increased source of purpose and validity to the unit, but then, that was the case from my perspective as well and my observations could be accused of being tainted.

These interviews are issues-centred. They deal with what is the best way to make a field trip successful, or what is the best water test kit to use? They are also responsive, seeing how the intent of the different centres is to change their programs for improvement over time and also responding in similar ways in the design of this new program in Oxford County (Kemmis, p. 66-68).

In the Oxford County program, a source of evaluation would have to be set up and run continuously with each use of the facility. The intent would be to see of the changes made at other centres were valid improvements to the program in Oxford and if any new changes were needed to improve any situations as they exist in Oxford County. This would have to be coordinated with Brian Grigg, the outdoor centre instructor and offered to teachers who bring their student groups to the centre for the aquatic study activity.

Is there a danger in interviewing other environmental educators that mistakes are being compounded since they are all teachers in the same area? It is something like Action Research in that you are asking insiders who have lived with the problems to recognize and fix the problems. Although you are asking experts in the field to fix any problems they may see or find they also have a personal tie to the program. Some of them were key figures in initiating the whole outdoor education concept in their area and in shepherding the program through their board's approval process. As such, they could hardly be seen as being unbiased to any degree.

For true action research to be used, you would need someone unconnected with the local program to be involved with its evaluation. They would also need to be experienced in the process of action research. They would need to know the aims &

objectives of the program or unit of study and look with some detail to see if the programs currently in place are meeting these aims and objectives. Since this is a grade 11 general course and outside the bounds of the Common Curriculum, the old language of objectives rather than outcomes remains in place. Teachers in the programs are regulating and adjusting their own programs, if it is done at all. Some centres, such as Pine River, offer no follow-up to classes and teachers after visits, so evaluation could be said to be non-existent. This is very close to the norm for most centres. The best plan for ongoing validation would be a common procedure and evaluation form to be given to all users of the site either after the program but the same day, or a follow-up questionnaire to their school. If there is time, the form filled out the same day is more likely to be finished and returned than a form in the mail.

There is an argument that the evaluation is only internal. Teachers from other boards are asked for evaluation information of their centre's programs, but are not themselves evaluating the program here. There were to be teachers outside Huron Park helping by filling out a questionnaire on their uses of the Oxford Centre. These teachers would still be in the same subject area, science. Is it internal if Brian Grigg at the centre is involved or does it have to be just teachers in the schools of Oxford County? Boundaries would have to be marked. The common subject area of science would make it appear fairly strongly an internal evaluation. As for it being an inclusive evaluation, students are involved, but neither parents nor administrators have been involved.

In order to get more secondary teachers involved in the evaluation of what they thought should be offered at the Oxford site, a questionnaire was prepared (see

appendix 8). It might be useful in the future, but for the purposes of this study, there were no secondary teachers using the site, in particular, teachers for this grade 11 aquatic unit field trip. Some grade 9 teachers from Ingersoll D.C.I. did use the site on two half-day trips. One teacher, Janet Thompson, collected organisms with her students in the morning while a second teacher did the same activity in the afternoon of the same day. The afternoon class found the site very muddied and found very few organisms – observational support for the field centres who explained they avoided muddy areas in their ponds as being very detrimental to the pond environment and disrupting data collection immensely.

Setting up a curriculum unit is not a very big "issue" that gets people involved enough for it to be inclusive and use all parts of the educational community, parents, students, administrators and teachers. It is big enough to get more teachers involved who have a personal interest in using the site for their class purposes. That was done as part of Dr. Sorger's Water Toxicology course. The main pond for student use at the centre was tested along with a second nearby pond. The data was to be used as a baseline so inexperienced teachers would know what to expect – an advanced "teachers' guide," if you like. The second pond could be used as a lesson extension if that was ever desired, or to test two nearby pond if more space were ever needed with a large group. A summary of this presentation can be seen in Appendix 7. The main summary point that several teachers noted was the desire to start and maintain ongoing testing to chart the state of at least the main pond over time so that students could see and use this "student database' as part of their work. The use of student "monitoring" is beginning to be used as a valid extension of scientific inquiry. It gives scientists

a much larger database, at a much lower cost and gives students the role of supporting professional scientists with their work (Stewart, 1998, p. 23, LaHart, 1998, p. 20)

Although invitations were given to all schools in the board, both elementary and secondary, and the meeting was held after 4:30 p.m. so that elementary teachers would have adequate travel time to reach Huron Park, only secondary teachers were present.

The methods used here for evaluation are modified multiple measures (Bennett, p.19). This gives a broader range of data for interpretation and lets one person spread around more efficiently. It is certainly not triangulation since only one person is doing the evaluation, not several. There is not enough time involved to do such procedures as long periods of observation nor client surveys for instance. These methods do, however give the individual "classroom teacher" some tools with which to work and some ways to systematically check the quality of the program and the reaching of program objectives.

Revisions for Future Field Trips

Revisions have been made to clean up the appearance of tests and questionnaires. More revisions such as those discussed earlier of placing open questions after the closed questions will be fit in as long as the form can be kept short and simple to make both its completion and interpretation a benefit to the program and not a penalty.

Kemmis talks about the practices of teachers modeling the discipline. Important in this are the "teaching activities employed by the teacher and whether they are related to the activities required in the subject itself" (p.82). One way to deal with this is

with critical incidents and role playing to get "in the mood" of the subject and situation. A critical incident is a short example of a situation that puts the environmental concern at hand in jeopardy. An example of this would be the farmer in the questionnaire who has the choice of filling in the pond in his field or leaving it in its "aquatic" state. This would generally just involve a discussion of the incident. Role playing would have students take various parts involved in the environmental issue and would generally deal with a larger issue such as the local court case over charges that a developer drained a wetland mentioned earlier. In these situations, the language of the real world situation would have to be used in classroom conversation, in proper context. A lot of practice should happen quickly. This should also serve as a check on their values and opinions, as they become involved in the discussion. And it could be "engaging" and thus experiential without leaving the classroom.

Updates of the organism identification sheets have been done, drawn by an environmental/art student from Huron Park and will be copyright to be legally available to use at the Oxford Board centre or other centres that wish to use them. Copyright infringement is a reality in most outdoor centres. Each centre got their identification sheets from a friend at another centre with the legal source long ago forgotten. All centres said they use only clear diagrams of organisms found in their ponds, not just general commercial keys for identification. This updating of the diagrams and lists would lead into other skill areas – an artistic area and a data collection and updating one.

To make the procedure more open and integrated, other departments such as Geography could be invited to participate to some degree – to map the area more

accurately perhaps. Thus, a non-Science observer would benefit a science project.

Other science teachers of the grade ten courses could become involved since they have an ecology unit dealing with food webs in their course. They have little experience in environmental areas in their course so a fresh eye and mind would be available for evaluating the program while they gain experience in identifying organisms and running and environmental field trip.

More collecting pans are needed, especially in the muddy water (to sort through thoroughly) and more practice with test kits seemed to be needed. It is more difficult to work in the field, especially at a muddy site, one possible explanation for complaints about the site and collecting methods not being easy to use.

Test kits will be restocked using Hach materials. Oxford County has two large boxes of old test kits – of the Lamotte variety, the one not as easily recommended. If the outdoor centre were to stalk all equipment and test kits on site, it would lower the cost for schools and prevent duplication of materials. Budgets could be shared to purchase one or two complete sets of the test materials to be on loan at the site or sent out to individual schools.

If the unit were offered in September, the students would be in their first semester, in their first unit, where a pretest will truly be a pretest. Numbers attending should be much higher and enthusiasm for doing a course should be high and absenteeism low.

Conclusions

The best situation would be a dock or boardwalk which would give students access to the study area and protect the organisms from harm when the mud is stirred

up with wading. This protective step was taken at Pine River Outdoor Education Centre near Shelburne (Royal, 1994).

Other steps would be to clear more of the shoreline of trees so that an area could be grassed to prevent erosion. Building a small dock – or two that would maximize viewing and collection and minimize disturbance. Finally, planting aquatic plants to improve the habitat and homes for aquatic organisms and cut down on the bare mud bottom.

With several evaluation methods in place and a watchful eye open to areas where improvements can be made, decisions can be made about the "quality" of the experience. Possible funding sources for this are the "Friends of the Environment Foundation at Canada Trust that funds local environmental initiatives; and Habitat 2000, a federal program from Environment Canada that supplies funding for projects that will improve habitat for biodiversity. This would give an ideal extension for student projects to support board programs – ie. make the site better for both students and the natural environment.

It can thus be kept on track to ensure it is meeting the objectives of the course of study, especially a respect for the natural environment.

CHAPTER 9:

POND RECOMMENDATIONS

The first and most important recommendation is to keep the outdoor centre open and the programs operating to provide this valuable experience for students.

After that, there is the need to improve the pond which has poor access to the collecting sites including muddy water which makes it difficult to find creatures and is hard on the creatures' environment. This skews the results with damage to the habitat & populations of creatures. A boardwalk would help a great deal since the shore is far too muddy. The boardwalk would help for safety, for better collecting of specimens and returning them undamaged, for finding specimens, so more students could be involved, and for leaving a habitat that could be used by others without being damaged each time. Digging the pond deeper would improve the habitat and mean less mud present overal overall.

Other ponds could be use, such as the Springbank (Brick) Ponds in Woodstock which are a 25 minute walk from Huron Park. This does not help other schools find a suitable alternative and the proximity of the road is dangerous. Fanshawe Conservation Area in east London has a pond study program for a fee which includes a school bus rental charge to get there. This would fit the students in Ingersoll and Thamesford who are fairly close, while students in Tillsonburg could go to the education centre at Backus Woods Conservation area near Long Point where both a pond and stream are available. All collecting materials and chemicals would be

provided for the trip cost, along with the expertise to lead the trip or provide very strong support.

Some boards do streams and this is being taken up by Patti Donelly, the new environmental instructor in Thames Valley District School Board. On an initiative from the local conservation authority (Thames Valley) and funding from local businesses, a committe has set up an excellent curriculum guide, It can be more exciting for students who can get near the area more easily, it is shallower, usually, and thus safer, and is thus available for better study. There is even a free bus provided!

Purchase Test Kits to be held at the centre for all class use and where the chemicals can be replenished more regularly to keep them fresh.

Pursue funding for the pond site through the local Friends of the Environment (Canada Trust) and Habitat 2000 which gives Federal money to support better habitat for species protection.

Finally, workshops for teachers on professional development days should be held regularly to show them what is available at the site, what currucula are available and the advantages of this type of activity for their students.

CHAPTER 10:

CONCLUSIONS:

There is much support for outdoor activities such as the aquatic field trip, from educators in the field in Ontario, from past recommendations from educators world-wide, and from students attending the programs (Eagle).

This project has provided resources for making it easier for teachers to plan and execute a field trip with their classes and with test instruments to judge the effectiveness of the experience. These instruments should be used continually to update areas where the activity could be improved.

There are several points to consider with the changing times in Ontario schools. The outdoor education centres have decreased since the Eagle & Richardson study in the early 80's. Evidence of this is in London where Circle R Ranch, a local outdoor centre has not been used by the board for years and at least two teachers have been removed from the program. In Waterloo, sites have been closed, and in Oxford, the teacher who retired was replaced with, not a "teacher" but a contracted instructor at a much lower cost. Board amalgamations may change the situation even more. Courses at S.S.'s are changing with no environmental science as a separate course. There are, however, signs that the new curricula being prepared at present will offer units of environmental topics over many science courses, an opportunity to use this field trip resource with more students. There is sufficient environmental material at the elementary level that

there is ample opportunity to use this resource there.

With the current government promoting a "return to basics" approach it is uncertain whether courses that have been optional will be supported. An area that has been supported by this government is lifetime leaning and career education, two areas that this field trip activity encourages and in which it gives experience. The fact that the units are spread around more science courses should mean that more students will have an opportunity for more of this outdoor/experiential activity, if teachers can be convince to use it (see workshops in recommendations).

Another area the government is promoting is computer use in schools. Again, this project activity fits well here for testing methods on site and for computational assistance in the classroom. There are also possibilities with Internet sites to publish your studies and link with other classes in other schools doing similar activities (see Appendix 10).

In addition, computer simulations can be used to substitute for or augment a field trip. These simulations are getting better, but is this experiential? That would need evaluation on a program by program basis. There is quite a difference between the older pond learning guide, "Puddles to Pondwater" and something like "Digital Wetlands" which takes advantage of CD-ROM and multimedia technology.

A new endeavour is appearing in schools, environmental monitoring (McClaren, 1998, p.6). It involves the environmental data collection of field trips, the computation work with computers and other scientific technology, and use of the Internet to add to the databases of scientists and to connect with other schools. This is being done in summer programs now by Oxford County students from Tillsonburg at

Backus Woods Conservation Area to the south (Torobin, 1998, p. A6). This activity provides a truly experiential education and provides scientists with a new source and abundance of data they could not gather on their own. Students are gathering real data for real scientists out in the real world. With more students becoming involved in this, there should be a good argument for maintaining existing facilities and programs.

Appendix 1:

Outdoor Education Centre: Staff Interview Questionnaire

Sample interview sheet for discussion at outdoor education centres

Water Quality Lab Interviews

1. What levels are taught water quality at your facility?

2. Info. for grades 10/11 -- How many students do this unit or activity?

3. Important things to do positively?

4. Things to avoid for successful lab?

5. Test kits used?

6. Tests used?

7. Amount of time spent by students at the water site?

8. Use of area for low impact?

9. What preliminary work is done?

10. What follow-up work is done?

11. Any curriculum evaluation methods used to test success of programm?

12. Disposal of used chemicals from test materials?

Appendix 2:

Student Pre and Post Tests

1. PRE TEST — AQUATIC ECOLOGY
2. Summary Sheet: PRE TEST — AQUATIC ECOLOGY
3. POST TEST — AQUATIC ECOLOGY
4. Summary Sheet: POST TEST — AQUATIC ECOLOGY

PRE TEST — AQUATIC ECOLOGY

Name: _____ Class: _____ Date: _____

***Instructions**: For each question, circle the one answer you think is correct. If there is space to write in an additional response or explanation, please do so.*

1. Which animal is a carnivore?
   a) snail
   b) crayfish
   c) fisher spider
   d) tadpole

2. Which animals would be most abundant in a pond?
   a) fish b) snail c) newt d) clam

3. Which group of animals would be most abundant in a pond?
   a) herbivores
   b) carnivores
   c) omnivores
   d) scavengers

4. Which organism would be found the most in any pond?
   a) spider
   b) algae
   c) crayfish
   d) fish

5. During daylight hours plants produce a great amount of:
   a) CO_2 b) 0_2 c) H_20 d) pH

6. If we were to get rid of all ponds that produce mosquitoes and black flies, it would:
   a) not affect us.
   b) be a good thing for humans.
   c) kill many good animals.
   d) prevent most diseases.

7. We should return all animals found in a pond back to the pond:
   a) to preserve life.
   b) because we are told to do it.
   c) so others can catch them.
   d) so they will not stink when they die on the bank.

8. If you were a farmer and you had a pond in your field, what would you do with the pond?
   a) fill it in so you could plant more corn and make more money.
   b) spray it to kill mosquitoe larva.
   c) fill it in because it causes flooding.
   d) leave it in its natural state.

Explain: _____

_____

9. Which aquatic animals should be killed?
   a) snakes b) blood suckers c) flies d) none.

Explain: _____

10. A pond is beneficial because:
   a) it supplies ducks for hunting.
   b) it supplies fish for fishing.
   c) it is the home of many animals.
   d) we can swim in it.

Summary Sheet: from questionnaire given to 10 students attending field trip

PRE TEST — AQUATIC ECOLOGY

Name: _____ Class: _____ Date: _____

***Instructions**: For each question, circle the one answer you think is correct. If there is space to write in an additional response or explanation, please do so.*

1. Which animal is a carnivore?
   a) snail
   b) crayfish **(3)**
   c) fisher spider **(4)**
   d) tadpole **(3)**

2. Which animals would be most abundant in a pond?
   a) fish **(5)** b) snail **(3.5)** c) newt **(.5)** d) clam **(1)**

3. Which group of animals would be most abundant in a pond?
   a) herbivores **(4)**
   b) carnivores **(1)**
   c) omnivores **(4)**
   d) scavengers **(1)**

4. Which organism would be found the most in any pond?
   a) spider
   b) algae **(10)**
   c) crayfish
   d) fish

5. During daylight hours plants produce a great amount of:
   a) CO_2 b) 0_2 **(9)** c) H_20 **(1)** d) pH

6. If we were to get rid of all ponds that produce mosquitoes and black flies, it would:
   a) not affect us.
   b) be a good thing for humans.
   c) kill many good animals. **(10)**
   d) prevent most diseases.

7. We should return all animals found in a pond back to the pond:
   a) to preserve life. **(10)**
   b) because we are told to do it.
   c) so others can catch them.
   d) so they will not stink when they die on the bank.

8. If you were a farmer and you had a pond in your field, what would you do with the pond?
   a) fill it in so you could plant more corn and make more money.
   b) spray it to kill mosquitoe larva.
   c) fill it in because it causes flooding.
   d) leave it in its natural state. **(10)**

Explain: _____

_____

9. Which aquatic animals should be killed?
   a) snakes b) blood suckers c) flies d) none **(9)** **1 NR**

Explain: _____

10. A pond is beneficial because:
   a) it supplies ducks for hunting.
   b) it supplies fish for fishing.
   c) it is the home of many animals. **(10)**
   d) we can swim in it.

POST TEST — AQUATIC ECOLOGY

Name: _____ Class: _____ Date: _____

Instructions: *For each question, circle the one answer you think is correct. If there is space to write in an additional response or explanation, please do so.*

1. We should return all life back into the pond because:
   a) others want to catch them. c) to preserve its life.
   b) they stink when they die. d) the teacher will be angry if we don't.

2. If we sprayed ponds to get rid of mosquitoes, it would:
   a) prevent diseases b) kill many good animals c) be good for humans d) not affect us

3. During daylight plants produce:
   a) C02 c) H20
   b) O2 d) pH

4. Which organism is found the most in ponds?
   a) algae c) fish
   b) spiders d) crayfish

5. Which group of animals would be found the most?
   a) carnivores c) omnivores
   b) herbivores d) scavengers

6. Which animals would be most abundant in a pond?
   a) newt b) fish c) spider d) snail.

7. Which animal is an herbivore?
   a) snail b) spider c) crayfish d) newt.

8. Ponds are good because:.
   a) we can swim in them c) it is the home of many animals.
   b) they attract ducks and geese for hunters d) we could fish in it.

9. Which animals should be eliminated from the pond ecosystem?
   a) snakes b) blood suckers c) black flies d) none of them.

Explain: _____

10. If you were a farmer with a pond in the middle of your field, what would you do?
    a) fill it in to grow more corn c) leave it in its natural state
    b) drain it to kill mosquitoes and snakes d) spray for mosquitoes

Explain: _____

_____

Summary Sheet: 6 students attended this class from the trip

POST TEST — AQUATIC ECOLOGY

Name: _____ Class: _____ Date: _____

Instructions: *For each question, circle the one answer you think is correct. If there is space to write in an additional response or explanation, please do so.*

1. We should return all life back into the pond because:
   a) others want to catch them. c) to preserve its life. **(6)**
   b) they stink when they die. d) the teacher will be angry if we don't.

2. If we sprayed ponds to get rid of mosquitoes, it would:
   a) prevent diseases b) kill many good animals **(6)** c) be good for humans d) not affect us

3. During daylight plants produce:
   a) C02 **(1)** c) H20
   b) O2 **(5)** d) pH

4. Which organism is found the most in ponds?
   a) algae **(5)** c) fish
   b) spiders **(1)** d) crayfish

5. Which group of animals would be found the most?
   a) carnivores **(2)** c) omnivores **(2)**
   b) herbivores **(1)** d) scavengers **(1)**

6. Which animals would be most abundant in a pond?
   a) newt b) fish **(1)** c) spider **(1)** d) snail **(4)**

7. Which animal is an herbivore? **(1 no response, same student)**
   a) snail **(4)** b) spider **(1)** c) crayfish d) newt.

8. Ponds are good because: **(1 no response)**
   a) we can swim in them c) it is the home of many animals. **(5)**
   b) they attract ducks and geese for hunters d) we could fish in it.

9. Which animals should be eliminated from the pond ecosystem? **(1 no response)**
   a) snakes b) blood suckers c) black flies d) none of them. **(5)**

Explain: _____

10. If you were a farmer with a pond in the middle of your field, what would you do?
    a) fill it in to grow more corn c) leave it in its natural state **(5)**
    b) drain it to kill mosquitoes and snakes d) spray for mosquitoes
    (1 no response)

Explain: _____

_____

Appendix 3:

Group Evaluation

GROUP EVALUATION — FRESH WATER ECOLOGY FIELD STUDY

Name: _____ Group name: _____

Circle your choice where appropriate!

1. Were all chemical tests completed and were all results recorded? Yes No

   If not, why? _____

2. Did everyone participate in the chemical tests? Yes No

   Is it important that everyone participates? Yes No

   Why? _____

3. Did you pollute or damage the pond, bank, or any part of the environment in which you were working, as a result of your chemical tests or your actions? Yes No

   Explain: _____

4. Did everyone in your group participate in the catching, identifying and recording of animals and plants? Yes No

   If not, why not? _____

5. Did your group demonstrate "respect for life" in your study? Yes No

   Explain: _____

6. Did your group work well together? Yes No

   If yes, why? _____

   _____

   If no, why not? _____

   _____

7. Do you believe that life in a pond is worth saving? Yes No

   Why? _____

8. If you were to rate your group's success, what letter would you assign yourselves?

A	B	C	D	E
excellent	very good	good	fair	poor

Appendix 4:

Student Lab: Group Debriefing

Water Quality Lab Debriefing, June 14, 1994

Wayne - good except for mosquitoes

Jackie - mosquitoes awful

Bob - I see what you mean about needing a dock (mud was pretty thick)

Tests:

OK

O_2 test had old material that was hard to scoop out in a measured amount.
(Lamotte kit)

No time to try each kit.

General:

- Need more time out there. It was wet and muddy.
- Good study but too rushed.
- I.D. sheets were good.

In future:

- Want more hands on work.

Attendance discussion in general for courses: (student suggestions)

Suggest 30 marks for attendance judged after the semester, and especially after the last class of the semester.

3 marks per day

- 1 at start (if on time)
- 1 during class
- 1 for working till end of class.

Appendix 5:

Field Trip Teacher Observations

Pond Lab Observations

10 students out of a class of 19 on trip.

Teacher thoughts.

1. Practice test kits ahead of time more.
2. Need more time at pond to I.D. organisms -- perhaps bring samples back to class.
3. Very muddy - hard to find organisms.
4. Need waders available -- too muddy & sticky -- lose boots in mud.
5. I.D. sheets - find good size representation & list only organisms in pond.
6. Some student not careful with organism. They dump them on the bank before getting more samples.

In general:

- Hard to find open areas to get to water for samples.
- Need more white tubs for collecting & viewing.
- Logs in way of getting to open water.
- Other side of pond - open area - very grown in with water plants.

Best situation — build dock or boardwalk to sample water & collect organisms without muddying water.

Appendix 6:

Student End of Unit Questionnaire

1. Water Ecology Student Questionnaire
2. Summary Sheet: Water Ecology Student Questionnaire

Water Ecology Student Questionnaire

In the questions where there is a space on the right, please put a number from 1 - 5 where 5 means high agreement and a better situation and 1 means low agreement or a poor recommendation.

The Unit:

1. This unit an activity was worthwhile? _____
2. It was an enjoyable unit? _____
3. Enough time was given for explanation of concepts? _____

The Field Trip for water testing:

4. Enough time was given for the collection and tests? _____
5. The tests were easy and understandable? _____
6. Visual guides were easy to follow? _____
7. The charts were easy to understand and fill in? _____
8. I would participated in another trip of this nature? _____
9. The $2 cost of the trip was about right? _____
10. The cost should be higher or lower? (circle one) H or L
11. Equipment was adequate for the activity? _____
12. Groups were of the proper size? _____
13. Your group cooperated to do the work? _____
14. One person did most of the work? _____

Follow-up after the trip:

15. Summary of the data was adequately covered? _____
16. Explanation of the results was clear? _____
17. You have a new understanding of what a pond is? _____
18. What improvements/recommendations do you have for the unit? _____

_____

_____

_____

19. Other comments: _____

_____

_____

(Use the back if necessary)

Summary Sheet: 6 students present from original 10 on trip!

Water Ecology Student Questionnaire

In the questions where there is a space on the right, please put a number from 1 - 5 where 5 means high agreement and a better situation and 1 means low agreement or a poor recommendation.

The Unit:	1	2	3	4	5
1. This unit an activity was worthwhile?	(1)			(3)	(2)
2. It was an enjoyable unit?	(1)			(3)	(2)
3. Enough time was given for explanation of concepts?	(1)	(3)	(1)		(1)
The Field Trip for water testing:					
4. Enough time was given for the collection and tests?	(4)	(2)			
5. The tests were easy and understandable?	(2)		(1)	(1)	(2)
6. Visual guides were easy to follow?	(1)		(3)		(2)
7. The charts were easy to understand and fill in?	(1)		(1)	(3)	(1)
8. I would participated in another trip of this nature?	(1)			(1)	(4)
9. The $2 cost of the trip was about right?			(1)		(5)
10. The cost should be higher or lower? (circle one)	**(5 H), (1 no response)**				
11. Equipment was adequate for the activity?	(1)	(1)	(1)	(2)	(1)
12. Groups were of the proper size?				(2)	(4)
13. Your group cooperated to do the work?		(1)	(1)		(4)
14. One person did most of the work?	(2)		(2)	(1)	(1)
Follow-up after the trip:					
15. Summary of the data was adequately covered?			(3)	(1)	(2)
16. Explanation of the results was clear?			(2)	(1)	(3)
17. You have a new understanding of what a pond is?			(1)	(1)	(4)

18. What improvements/recommendations do you have for the unit?

- **It didn't have to rain, but that's not your fault and it would of been nice to have gone a whole day to bonfire for lunch/walk on nature trail and tests ect. using the microscopes.**
- **Revamp the O_2 test kits. Need more sulphide powder. More time at Outdoor Ed. Centre**
- **I think in the future you should charge around $5, but have a whole day to do the study to explain yourself more.**
- **Should have covered more in class first.**
- **Go over it an other units faster with way fewer interruptions.**

19. Other comments:

- **General it was pretty good.**
- **Idea & concept is great. We need more time & preparation though.**
- **Good overall unit except for mosquitos.**

(Use the back if necessary)

Appendix 7:

Community Presentation to Oxford Teachers

1. Community Presentation: Summary Report
2. Water Testing Transparencies: a) Purpose and Tests
   b) Test Data and Summary
3. Water Quality Questionnaire: Community of Teachers

Community Presentation (Thursday, November 24, 1994)

Water Test Results Oxford County Outdoor Education Centre

Bill Thompson

The presentation was made at Huron Park S.S. in Woodstock, secondary school closest to the outdoor education centre and also my school. Teachers from other schools were invited to the meeting, as well as members from the HPSS science department with an interest in environmental science and the centre. These people did attend along with Brian Gregg, the instructor at the centre. The total audience was five. Most had inquired about the time involved and were relieved to find out it would be from 4 pm to 4:30 pm. The wait from 3:20 to 4:00 was to allow teachers from other schools to attend. I was worried it would backfire and I would not get either audience, but Brian needed the time to get here and the others were entertained in the Library by a social on the U.S. Thanksgiving Holiday. We were celebrating not being in the U.S. celebrating their Thanksgiving.

Use of an overhead was made to display 3 transparencies of the goals, map of the pond area, and data results. A verbal disclaimer was made before presenting the data to say that it was not legally valid but scientifically valid because of the replication of tests over a three week period, and most tests were also duplicated (not the DO and I wish it was). The data was presented after the goals were stated and the area map was discussed.

Discussion occurred both during the presentation and after. Questions involved the site itself and its background and some questions involved Brian. They were posed to Brian directly. The group is very cooperative so it was easy to get them back focused at the front and the feeling I had was not of competition but of sharing the information and trying to figure out what was going on at the site. Surprise was voiced at the high readings of ammonia at Pond B and discussion focused at the makeup of bottom sediments and the surrounding vegetation that would lead to these results. I felt able to handle all discussion but it became a little sticky when dealing with the DO and the invalid results with the extremely high readings from Pond B. Perhaps that was because I already felt uncomfortable with it. Perhaps the wolves could smell the fear? It turned into a focal point for some good discussion. It also led into a question about what the saturation level really meant. This was posed by the person I knew would ask some tricky question, he had taught this course before and has a nice quiet inquisitiveness about him. I answered his question but he was not satisfied (and I had answered it correctly). Later I found the lab guide included in the appendix, and gave him a copy. He was still not satisfied.

His question had been what does the per cent saturation really mean? Was it the oxygen entering from the atmosphere only and if so, what about the oxygen added by plants? I had answered that it was the total saturation and was governed by the temperature of the water at the time of sampling. My comment was that saturation meant it could not hold any more than the total level allowed by that temperature. He later agreed with me and if I had use the term "equilibrium" it would have made things better. Basically, it is saturated from the atmosphere and any addition from plant forms is in equilibrium with that amount and subject to the temperature of the water.

The presentation took about 20 minutes with discussion after that. This was in conjunction with discussion of how to use other classes to keep tabs of the water quality and included Brian, the resident instructor.

The survey sheets were distributed near the end of this and they generated a little more discussion (copies are included). People felt it was worthwhile and were willing to devote their time and class time to the project, but not money. This could be because they are cheap teachers but more likely they see this as a board sponsored initiative (or it should be), as well as an opportunity for students to take part.

It was interesting to see the comments about the presentation (mine). They were mostly complimentary, but one mentions the goals were missed (or at least he missed them). I thought they were clearly stated and others did as well. I need to look for another way to check on the response to a question. Perhaps a more open area to give their ideas for an improvement. At least that would give more of an idea of what exactly they meant.

After a lull in the discussion I brought out the two types of indicator plates for choliform and fecal coliform testing to discuss the methods used and why (even though my tests were negative). I thought this was the part they would be least familiar with and would be a good area to "teach" the teacher. It drew more interest. But there was still one comment on the questionnaires about going into more detail on some of the tests. I thought I had done this. It does no good to mention that there was adequate time for discussion when this point could have been raised, and the bacteria testing discussion introduced the topic. I will have to keep this in mind next time and perhaps try to force this issue more directly with specific mention of more discussion or the loan of the lab manual.

This was a very useful experience and forced preparation in simplicity and clarity. Thinking through the concepts, both before and after the presentation helped clarify the test items and their relationship to water quality. This is needed if I am going to deal with these concepts in presenting them to students.

Water Testing

Oxford County Outdoor Education Centre

Purpose:

To gain an accurate picture of the water quality at this site

1. To see that it is safe for the many elementary students sampling the pond.
2. To have a clear idea of expected results when classes do their own testing (given that results will vary seasonaly).

Tests Done:

3. Ammonia
4. Phospates
5. Dissolved oxygen
6. *E. coli* bacteria

Test data and summary

mg Ammonium nitrogen per litre			
	Nov.1	Nov. 8	Nov. 15
Pond A	0.28	0.14	0.21
	0.28	0.14	0.21
Pond B	2.46	2.8	1.8
	2.46	3.3	1.7

The permissible level for safety is 0.5 mg/l ammonia nitrogen
Higher levels become toxic.
Lower levels encourage the growth of algae, fungi, and bacteria.

Phosphates (mg phosphate phosphorus/L)			
	Nov.1	Nov. 8	Nov. 15
Pond A	0.01	0.015	0.02
	0.01	0.01	0.02
Pond B	0.02	0.03	0.02
	0.03	0.04	0.01

There is no recognized limit to the levels of phosphates.
It is the main limiting nutrient when looking at growth of aquatic organisms such as algae.
The usual levels in water are 0.01 to 0.05 mg phosphate phosphorus/l
High levels are a sign of eutrophication

Dissolved Oxygen (DO) in mg /l						
	Nov.1		Nov. 8		Nov. 15	
Pond A	10°C	8.7	10°C	11.2	8°C	10.3
Pond B	10°C	4.8	11°C	10	11°C	16

At 10°C the solubility is **11.3 mg/l** DO
High oxygen can indicate low eutrophication or high algal photosynthesis during day which can lead to high eutrophication
Low oxygen indicates a lot of decay with fungi and bacteria using up the oxygen through respiration. Decay goes hand in hand with high nitrogen.

Water Quality Questionnaire: Community of Teachers

1. Was the water testing worthwhile? Yes No

Comment: _____

2. Are you surprised by the results? Yes No

Comment: _____

3. Would you like a testing program continued? Yes No

Comment: _____

4. How often should this testing be done? 2X/yr. 1/yr. 1 in 2 yr 1 in 5 year

5. Would you contribute time or money to this type of monitoring?

a) Time: Yes No

b) Amount (please circle) 1 hr/wk 1 hr/mnth 5 hr/mnth 2 hr/6 mnth

c) Money: Yes No

d) Amount (please circle) $10 $25 $50 $75 $100 Other:

6. Do you think water quality here is a cause for worry? Yes No

Comment: _____

Presentation (please evaluate where 5 is the higher score)

1. Was the topic clearly introduced? 5 4 3 2 1

Comment: _____

2. Was the data clearly outlined 5 4 3 2 1

Comment: _____

3. All questions discussed were clearly answered 5 4 3 2 1

Comment: _____

4. Areas to improve: _____

_____

_____

Appendix 8:

Oxford County Teacher Questionnaire: Attendance at Outdoor Education Centre

This questionnaire was originally prepared to survey the attendance at the outdoor education centre. When the sampling began, the responses from secondary teachers were all no's, leaving the remainder of the questionnaire blank. Most of the use is by elementary classes with only 2 secondary teachers using the site in a 3 year period for their grade 9 science classes. The questionnaire is left as an evaluation instrument to use in future program considerations at any level.

Teacher Questionnaire: Outdoor Ed. Centre Use in Oxford County

1. a) Have you been to the Outdoor Ed. Centre in the past 3 years? Yes No

   b) If yes, how many times? _____

2. What grade levels did you take to the centre? _____

3. Have you been to the centre with students this year? Yes No

4. What grade levels did you take to the centre? _____

5. How many students attended each visit? _____

6. What topics did your classes deal with? _____

_____

_____

7. Have you ever been to the outdoor ed. centre, with or without students? Yes No

8. Do you have plans to attend the centre next year? Yes No

9. If yes, what programmes will you be using? (What lesson topic)?

_____

10. Did you know the board will subsidize a bus for student visits to the centre? Yes No

11. If you have not been to the centre with students, what were the reasons for not doing so?

_____

_____

12. What parts of the centre did you feel were most used or worthwhile for your students?

_____

_____

13. What aspects of the programme should be changed? _____

_____

14. Are there any other areas you would like emphasized or offered at the centre?

_____

_____

(Continued on back!)

Outdoor Ed. Centre Program Evaluation (on a scale from 1 - 5 where 5 is most agreed)

1. The program set up for my classes met my students' needs.	**1**	**2**	**3**	**4**	**5**
2. The program was flexible and was tailored to my needs.	**1**	**2**	**3**	**4**	**5**
3. The Outdoor Ed. instructor let me join in the presentation of the lesson.	**1**	**2**	**3**	**4**	**5**
4. The Outdoor Ed. instructor should be the sole teacher during the visit.	**1**	**2**	**3**	**4**	**5**
5. Students should have free time when at the centre.	**1**	**2**	**3**	**4**	**5**
6. The Programme attempted too much in the allotted time period.	**1**	**2**	**3**	**4**	**5**
7. The Programme filled the time period adequately.	**1**	**2**	**3**	**4**	**5**
8. The Programme needed to be longer to fill the time period.	**1**	**2**	**3**	**4**	**5**

Appendix 9:

Water Testing Kits

Water Testing Kits

Hach

Most centres/teachers use Hach test kits for chemical testing. They are fairly easy to use and can be replenished easily in the original containers. They have been criticized as being expensive (CO2 being $150 plus) and also for giving a number measurement as if by magic without the chemistry of the measurement method being explained. For the needs of the grade 11 general course, the testing chemistry could get in the way of the students' understanding of the water chemistry – the real focus of the unit.

Boreal

Boreal's pre measured vials were tried but did not prove very satisfactory. They leave more plastic container debris, some parts of which splintered and were a small hazard to handle. The vials took away from the students' measuring skills since they did not have to measure the water and add certain amounts of test chemicals to it. Nor do students need to drop in chemicals to show a titration method, but merely open a vacuum-sealed vial and allow the correct amount of test water to fill the space.

LaMotte

Lammott is another company that sells test kits. These were generally considered to be more difficult to use but would give more accurate results than Hach kits. (Not a concern with this unit and student level and the discussion needed).

Brew Your Own Chemicals

Dr. G. Sorger, who teaches the water toxicology course at McMaster provides an excellent lab manual with "recipes" for all the water testing chemicals. This gives you a fresh supply of chemicals when you test but is very time consuming in preparation, something not in large supply in a high school (the time and perhaps the chemicals). If you have the back ground and the motivation, this could save money – how much is your time worth?

Bill Babbit's Do It Yourself Chemistry

A private consultant from the Belleville area, Bill offers workshops for teachers in a variety of subjects, with home made equipment and chemistry the focus. Comments I have heard after these workshops – besides the help and ideas they provide – have focused on the personal time needed to get the materials together and to find the supplies needed for some of the collecting devices. You have to love what you are doing.

Some teachers may find any of these methods useful and useable for them.

Appendix 10:

Curriculum Resources

During the preparation of this unit and the Masters' Project, the following resources were found to be useful for a teacher preparing this unit.

Curriculum Resources for Pond Studies

(Web sites were found by doing a search on the Internet using Pond Study as the basic search key)

Books:

Andrews, William. (1987). *Investigating Aquatic Ecosystems* (ISBN: 0-13-503129-X), Scarborough: Prentice Hall.

Taylor, Barbara, *Pond Life* (ISBN: BH-1879431947), $9.95 US (available on The Black Hills Parks and Forests Internet Bookstore Page – http://mesaverde.org/A/BH/ASOC/1879431947/page.aoi — or any the National Parks Electronic Bookstore Page)

Environmental Monitoring, *Green Teacher*, #55, Spring-Summer 1998, Tim Grant, Ed. (ISSN 1192-1285. 95 Robert St., Toronto, ON M5S 2K5, 416-960-1244

The Magnetism of Ponds, *Green Teacher*, #48, June-September 1996, Tim Grant, Ed. (ISSN 1192-1285. 95 Robert St., Toronto, ON M5S 2K5, 416-960-1244

WEB Sites, Internet Sources:

The Evergreen Foundation's Ecology Resources Network, *Natural Schools: Outdoor Classroom – Amphibian Voice*, by Heather Gosselin, Adopt-A-Pond Program, Metropolitan Toronto Zoo (http://www.evergreen.ca/nsoc2pond.html). A page of information concerning the program to have Canadian schools adopt a wetland area to raise awareness about it and save it from being lost.

Pond Dipping, by Roy Winsby, Microscopy UK - 'Home' of Amateur Microscopy on the Web!, (http://www.microscopy-uk.ort.uk.mag/articles/dipping.html). Description of collecting technique for gathering pond organisms for microscope viewing.

Microscopes, Cells, DNA and You, Possible Independent Projects, Pond Water: (http// chroma.mbt.washington.edu/outreach/SUGGESTIONS.html). The pond listing for possible student projects lists 6 different studies to do around pond organisms.

Life in Your Local Pond: Project Watch (http://www.eduplace.com/hmco/school/projects/pond.html). This web page is sponsored by Houghton Mifflin Co. and is a project for students aged 9 to 12 to carry our research on their local ponds and share this information with students at other schools linked on the Internet.

Digital Learning Center for Microbial Ecology, Microbe World, Water World (http://commtechlab.msu.edu/CTLprojects/dlc-me/zoo/zwpmain.html). This site is from: Michigan State University, Communication Technology Laboratory, Center for Microbial Ecology. In a very brief, clear manner, it outlines the microbial elements that will be found in a pond. An excellent background for those studying a pond to easily gain background in the "unseen" elements of a pond that can still have a major effect on its balance.

The In-Pond Digester (http://garnet.berkeley.ecu/~fbgreen/digester.html). Center for Applied Phycology, University of California, Berkeley.
A good diagram of a pond with explanation of how they can function to treat raw sewage, giving the organisms involved and the process. A good addition to the normal pond material.

Videos:

Pond-Life Food Web (V6236 at the Oxford Board) – 16 min.
A look at pond inhabitants at the microscopic level, identifying creatures and their interactions.

Swamp Ecosystem (to be purchased by the Oxford Board) – 16 min. A look at a very large peat bog.

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