# SUBSTANTIATION FOR THE INTEGRATION OF OUTDOOR ACTIVITIES INTO THE QUEBEC ECOLOGY CURRICULUM

by

Serge Melançon

Monograph

Submitted to the Faculty of
Graduate Studies and Research
in partial fulfillment of the
requirements for the Degree of
Master of Education in the
Teaching of Biology.

Advisor: Professor Pearl Francoeur
Faculty of Education
McGill University
Montreal

August 1990

# ACKNOWLEDGEMENTS

To my wife Joanne for the many hours of patience while I worked on this monograph, and to professor Pearl Francoeur, whose support and suggestions were truly appreciated.

# TABLE OF CONTENTS

## ABSTRACT

The purpose of this monograph was to assess the potential value of integrating outdoor activities into the Quebec Secondary I Ecology Curriculum. In order to achieve this objective, three approaches were used. Firstly, a survey of the contemporary needs of science education in the area of ecology was undertaken in order to identify where outdoor experience could be most required. It appears that at the eve of the 21st century, attention should be payed not only to the discipline, but also to the individual and the social levels of education. Environmental awareness and scientific literacy are among the two main preoccupations of contemporary science education. Secondly, using a survey of the arguments of educators who advocate using field trips, a presentation of the theoretical value of outdoor education was made. Many outstanding educators have advocated the advantages of out-of-the-classroom settings in the areas mentioned above. And thirdly, a review of the scientific research on outdoor ecology-related activities was assembled to permit an assessment of the practical value of outdoor ecology education. Fifteen studies were reviewed; ten of them dealt directly with ecology, and the other five had portions of their learning program on ecological concepts. In light of the research reviewed, it would appear that

learning can take place in the out-of-doors. Most of the studies also showed that cognitive achievement in the areas of knowledge and comprehension was greater in the out-of-doors than in the traditional classroom environment. The very few studies that were reviewed which tried to assess the affective value of ecological field trips showed significant positive differences in the outdoor experiences over the indoor classroom environment in the areas of environmental awareness and classroom climate. Considering the importance that is now placed on the environmental crisis and the need for students to become scientifically literate, it would appear that outdoor education has the potential to facilitate the MEQ ecology curriculum learning objectives. The author reiterates, however, the need for more research in the areas of cognitive and affective outdoor learning in environmental education. The difficulty of measuring efficiently some of the learning outcomes, the great diversity of the experimental designs, the scarcity of relevant and pertinent material related to junior high school ecology, and other related problems support this recommendation.

# RESUME

Le but de cette monographie est d'étudier la valeur potentielle de l'éducation en plein air afin d'envisager l'intégration d'excursions écologiques au guide pédagogique d'écologie, secondaire I, du Ministère de l'Education du Québec. Trois aspects ont été considérés dans cette étude:

1) D'abord, une étude des besoins contemporains en éducation des sciences et plus spécialement en écologie a été entreprise afin d'identifier les éléments d'apprentissage dans lesquels le plein air pourrait être utilisé. Suite à cette étude, il s'avère qu'à la veille du vingt et unième siècle l'éducation se concentrera de plus en plus au développement de toute la personne; c'est à dire à la fois au niveau académique, au niveau de l'individu et au niveau des besoins sociaux. La conscientisation environnementale ainsi que la démarche scientifique demeureront deux objectifs majeurs en science écologique.

2) Un tour d'horizon des opinions de différents spécialistes en éducation sur l'efficacité des activités extérieures a permis d'en établir la valeur théorique. Les arguments en faveur de l'éducation des sciences au grand air

sont nombreux et soutiennent l'enseignement hors de la salle de classe pour les éléments éducatifs mentionnés plus haut.

3) Enfin, la qualité pratique, très concrète , de l'éducation en plein air pour l'enseignement de l'écologie a été abordée dans cette monographie. Tous les travaux scientifiques disponibles qui ont traité de près ou de loin des expériences écologiques en milieu de plein air ont fait l'objet d'une étude attentive. Au total quinze travaux ont été sélectionnés dont dix d'entre eux furent directement reliés à l'apprentissage des notions écologiques en milieu extérieur. A la lumière de cette recherche, toutes les etudes consultées ont indiqué que l'apprentissage des sciences naturelles est possible grâce aux méthodes d'enseignement axées sur le plein air. De plus, la majorité des études comparatives plein air/salle de classe ont favorisé les techniques de plein air pour l'apprentissage cognitif dans les domaines de la connaissance et de la compréhension suite aux résultats obtenus dans les tests d'évaluation. De la même manière, le peu d'études consultés par l'auteur qui traitaient de l'aspect affectif de l'apprentissage écologique ont majoritairement favorisé les méthodes de plein air en ce qui a trait au développement d'une conscience environnementale.

Malgré le potentiel apparent des techniques de plein air à repondre, en partie du moins, aux besoins contemporains de l'éducation des sciences, l'auteur ne peut recommender immédiatement l'intégration d'un programme de plein air au guide pédagogique, écologie secondaire I, du Ministère de l'Education du Québec. La difficulté de comparer la grande diversité des travaux scientifiques aux niveaux qualité, méthodes expérimentales, échantillonnage et contenu obligent une telle prudence. L'auteur encourage la poursuite des recherches dans ce domaine tout en suggérant aux éventuels chercheurs des lignes maîtresses à suivre pour bien evaluer l'efficacité des techniques de plein air dans le cadre des objectifs d'apprentissage en écologie.

# LIST OF TABLES

# CHAPTER I

## GENERAL INTRODUCTION

"Any theory of education which contemplates
a more unified scheme of education than
now exists is under the necessity of
facing the question of the relation
of man to nature"

John Dewey (1916)

# CHAPTER I

# GENERAL INTRODUCTION

## 1. Introduction

The educational value of field trips has been accepted by teachers for decades. Over 40 years ago, Heiss, Obourn, and Hoffman (1950) stated that the modern science teacher must use the resources of the community to supplement and enrich science teaching. More recent authors (Hammerman and Hammerman, 1973; Postlewait, 1980; Thier, 1981; Adams, 1982; Meyer and Rao, 1984) have also stressed the need to integrate outdoor activities into the science curriculum.

In ecology, which is the study of the science of concrete interactions in the environment, the virtues of field activities have perhaps been discussed more than any other subjects (e.g.Sankey, 1958; Lambert and Goodman, 1967; Bennett and Humphries, 1974; Hale, 1986; Sheail, 1987 and

Wheater, 1989). In fact, ecology is, by definition, a field subject as Wratten and Fry (1980) once pointed out, and, without field work, it ceases to be ecology (Proctor, 1967), or at least it becomes pointless (Mantle and Heath, 1986).

2. Statement of the problem

The Ecology Curriculum, published by the Ministry of Education of the Province of Quebec (MEQ) in 1983 and designed to be used by secondary school teachers, does not prescribe any particular method, but recognizes in the outdoors a valid approach to the teaching of ecology. The role of field investigations, however, appears to take a rather minor part of the course if one judges by the number of outdoor activities proposed in its curriculum guide (Gouvernement du Quebec, 1987, pp. 69-174). Of these suggested activities, less than ten percent of what can be identified as field work is being presented. It is hoped that this low percentage does not reflect the importance that the M.E.Q. places on outdoor ecology. Without a firm stand in favor of outdoor ecology and clear policies with regard to its implementation into the curriculum, it is illusive to believe that teachers will naturally be inclined to create an outdoor program for the ecology course. A survey by Duane Keown (1986), conducted to determine the use of outdoor resources in the teaching of natural science in

US secondary schools, indicates that the majority of the classes use outdoor resources fewer than three times during the school year. Other surveys (Hall and Wright, 1980; Bokhorji-Ghawanni, 1985) have come to similar conclusions. As far as ecology is specifically concerned, there is no indication that the situation is different[1]. Our educational system cannot rely strictly upon the initiative of the teaching staff. Major decisions must first be taken at a higher hierarchical level to facilitate program implementation.

Prior to the integration of outdoor activities into the ecology curriculum, there is a need to assess the real value of outdoor ecology. Considering travel expenses and other impediments, the MEQ cannot commit itself to this cause without being sure that outdoor education represents elements essential to the only adequate response needed for achieving the objectives of the ecology course.

Our findings suggest that no available review studies have been reported specifically on the educational outcomes

---

[1]Monica Hale, Manager of the Urban Spaces Scheme of the Department of Food and Biological Sciences at the Polytechnic of North London in England (Hale, 1986), has stated that "although ecology is implicitly referring to the field situation, it is predominantly taught in the classroom".

of outdoor ecology. Most review papers produced so far have made an attempt to assess the value of outdoor education in general. The first survey known to the author was made by Sorrentino and Bell (1970) who computed the frequency of the judgement values made by educators following secondary science field trips. They concluded that, based on the opinions reported in the literature, secondary science field trips were considered valuable. They have presented 16 reasons for their claim. This conclusion, however, was based on attributed values and not empirical studies. Koran and Baker (1979) have evaluated the effectiveness of field experiences in their review of eight field trip studies. They concluded that outdoor experiences did not appear to exceed classroom learning on measures of knowledge gained or content learned, and that any justification for using field trips as a requirement in the school curriculum would need to consist of unique outcomes based on evidence that arises from the experience of field trips. Crompton and Sellar (1981) have published a summary of the affective learning outcomes resulting from outdoor education experiences. In their survey the findings of five science activities were studied. Their major conclusion was that although the research they reviewed generally was supportive of claims that outdoor educational experiences facilitate positive affective development, the results were still inconclusive due to the sparsity of evaluative research and the inferior quality of some of the studies they reviewed.

The first survey which was more closely related to outdoor ecology, concerns a review by Backman and Crompton (1984) on environmental outdoor education, with students nine to 16 years old assessing cognitive learning. These authors concluded that the evaluative research reviewed, based on eight studies, offered only qualified support for the value of outdoor education in facilitating cognitive development. In 1987, John Disinger reported the results of eight studies examining cognitive learning outcomes of elementary school students following activities in the environment. This reviewer claimed that there was ample evidence that instruction in the environment was useful for promoting and achieving cognitive gain but that there was a need to incorporate these meaningful outdoor activities into indoor teaching. In the same year Lisowski and Disinger (1987) reviewed 13 studies with secondary school students, carried out from 1935-1987, on cognitive learning in the environment. Following their analysis of these studies, they concluded that field-based instruction, as a teaching technique, was worthy of additional well-designed implementation by practitioners.

3. Purpose of the study

The purpose of this study was to assess the possible value of integrating outdoor activities into the Quebec Secondary I Ecology Curriculum. In order to achieve this objective, three approaches were used. Firstly, a survey of the contemporary needs of science education in this area will be undertaken to identify where the educational needs are in this field and, more specifically, in ecology. Secondly, using the surveys of educators who advocate for outdoor education, of the arguements and evidence offered concerning the theoretical value of outdoor education will be made. And thirdly, a review of the scientific research on outdoor-indoor science activities will be assembled to permit an assessment of the practical value of outdoor ecological education.

4. Limitation of the study

The following is a list of limitations imposed upon this study:

Only the Quebec Secondary I Ecology Curriculum was examined and analysed in this study. Most research studies that attempted to follow scientific procedures which might have offered insights into the ability of outdoor science activities to reach the Quebec Ministry of Education's objectives and goals in ecology were studied.

A major problem in researching outdoor education was the scarcity of relevant and pertinent material related strictly to ecology secondary I. Researchers tended to combine ecology with other academic subjects and/or students' grade levels.

5. Definition of terms

The following is a list of definitions of terms as they are used within the context of this investigation:

Affective domain: The area pertaining to those objectives which are related to a student's emotional nature. Included in the affective domain are the student's attitudes, values, interests, and feelings (see Krathwohl et al, 1964 for complete description).

Cognitive domain: The area pertaining to the subject matter content of a curriculum (see Bloom, 1956, for complete description).

Control group: Research studies reviewed in this monograph use two acceptations of this term: (1) the students who have not participated in the outdoor field experience nor in the indoor activities and

(2) the students who participated in the indoor activities.

Ecology: A specialized branch of the biological science which focuses on interrelationships between living things and non-living things in the natural environment and how these interactions bring about exchanges of matter and energy (MEQ Ecology Curriculum Guide, 1987, p.11).

Environmental Education: The teaching of the principles of ecology with an emphasis on practical applications in the environment and a consideration for related factors (economic, political, social and historical factors).

Experimental group: Those students who have participated in either the field experience or the indoor activities.

Field trips: Any journey taken under the auspices of the school for educational purposes. This may include visits to museums, a science camp or an outdoor hike to a natural site, etc.

Values: Any important positive psychological,social, moral, or aesthetic characteristics that are worthy outcomes of an educational experience. Two types of values were identified: The judgment values that concern values attributed subjectively by people, and empirically-determined values based on scientific results.

# CHAPTER II

## SCIENCE EDUCATION

## AND

## CONTEMPORARY CONCERNS

"That which can be learned in the classroom
should be taught there, and that which can
best be learned in the out-of-doors
should there be taught."

Sharp (1952)

## CHAPTER II

## SCIENCE EDUCATION

## AND

## CONTEMPORARY CONCERNS

### 1. Introduction

The purpose of this study was to assess the cognitive and affective outcomes of outdoor ecology-related experiences in order to substantiate the usefulness of their integration into the Quebec Ecology Sec. I Curriculum. This chapter reviews contemporary concerns in science education. The present research will unveil the raisons d'etres behind the development and teaching of the new Ecology Secondary I Curriculum in Quebec. It is believed that one can better comprehend the need for a well-orchestrated outdoor education program adapted as a strategy for teaching-learning to the ecology curriculum after a brief study of the present situation in science education in North America.

The author has identified three major concerns with regard to science education, and, more specifically, ecology.

2. A concern for the discipline.

Various studies performed in the USA have tried to determine the educational needs in the teaching of science. Project Synthesis (Harms, 1977), a research study aimed at identifying educational needs in natural science education, concluded that there was virtually no evidence of science being learned by direct experience. More recent national surveys, according to Kennedy and Hickman (1981) and Yager (1986), also indicate that biology teachers (including ecology teachers) primarily utilize a lecture mode rather than an inquiry mode so that the teaching of biology and ecology remain traditional and conventional. Transmitting subject knowledge therefore persists as a major goal of biology and ecology teachers.

This traditionalist approach seems to have negative effects on the students if one considers surveys such as the one reported by McCormack (1984), and Gaudin (1984). According to these authors, the teaching of science has not produced satisfactory results. Students do not have the knowledge and skills to move to higher levels of work in the sciences; they lack the scientific attitudes so important for scientific literacy. Their ability to formulate questions and seek answers from observations appears deficient. They do not know specific subject area content knowledge. They are unable to recognize a given scientific principle presented in a new context and they seem to be deficient in reasoning and problem-solving skills. The lack of enthusiasm and motivation seems to be the reason for this "handicap". Yager reported that 90% of high school students grow into adults who pay no attention at all to science. This survey indicates how apathetic the students tend to be towards science.

The Ministry of Education in Quebec (M.E.Q.), although defending itself from prescribing any teaching methods, strongly supports any approach that would be conducive to the development of a scientific attitude. The discovery method -based on activity, reflection, and knowledge, the inquiry method -focusing on spontaneous learning, imagination, and common sense, and the independent work method -stressing the pupil's interest and sense of curiosity are suggested teaching approaches in the ecology course. It is hoped by the M.E.Q. that these methods will bring about a change of attitude on the part of the students towards science.

3. More concern for the individual

This humanistic objective was strongly emphasized by Dewey in the early 1900's. In such a view, the curriculum is centered around the learner instead of the discipline. Information is selected according to the child's own needs, and not according to some pre-determined objectives prescribed by the discipline. Despite the great influence of Dewey's ideas over the American schools, it seems that modern science still tends to be discipline-bound and textbook-controlled. Here is a conclusion drawn by Yager (1986) in this regard:

> "We continue to push mastery of "our" science (that found in the textbook) even though the approach decreases student interests..."
>
> "The major shortcoming of school science seems to be the prevalent notion that its primary aim is to prepare students for further study."
>
> "It is rare to find a program that helps students deal with immediate personal problems. "
>
> (Yager, 1986, p.147)

The Ecology Curriculum Guide mentions this problem and suggests that teachers make the most of community resources (both facilities and people) to help the child's own development:

> "The main objective of a science course is to develop in the pupil skills and knowledge that will be useful to him"...
>
> (Ecology Document, 1983, p.10)

4. A concern for the society.

There is a growing concern about the quality of our environment. Pollution is increasing at such a rate that very soon mankind will be faced with unsolvable problems that could jeopardize his survival. Lebreton and Samuel (1976) quoted the ecologist, Pauline Gratz, as stating:

> "our urban as well as rural areas are being plagued with complex biological-physical-social problems, such as indiscriminate use of pesticides, community blight, air and water pollution, traffic congestion, lack of comprehensive environmental planning, and lack of institutional arrangements needed to cope effectively with environmental problems."

Many groups have recognized the need to educate the young generations if an environmental ethic is to be cultivated and perpetuated in our society. The International Union for Conservation of Nature and Natural Resources (World Conservation Strategy, 1980), to name only one, recognizes that environmental awareness should begin with school education. According to Alan Wagar, a non-environmental educator, there is a need to educate people so that an environmental catastrophe can be avoided:

> "From my slightly detached point of view, I conclude that we face an environmental crisis and that the challenge of environment education is no less than that of preventing disaster for the human race."
>
> (Wagar, 1970, p. 15)

When one takes a look at our present society of consumers who continue to spoil the environment despite the great dangers the planet is now facing, one can question the efficiency of our schools in educating the people adequately. Lynton Caldwell, a devoted environmentalist, emphasizes the important role of education with regard to nature conservation:

> "The quality of the future environment depends therefore upon the shaping of attitudes, beliefs, and values through present education."
>
> (Caldwell, 1970, p.6)

The same author also recognizes the failure of our present educational system to fulfill this essential task:

> "It is especially important that basic environmental concepts be built into secondary education where they have heretofore generally been lacking."
>
> (Caldwell, 1970, p.7)

Since ecology is directly concerned with environment, the MEQ has felt that its curriculum should aim at educating the students according to the pressing societal needs such as environmental conservation. In fact, for the MEQ, nature protection constitutes a major theme in the ecology course.

> "This course focuses on the following values: respect for life, a regard for the community and the environment,"...
>
> (Ecology Document, 1983, p.8)

It is believed that the development of good ecological thinking in our youngsters will produce future generations of adults who are ecologically literate and, consequently, who make responsible decisions regarding environmental protection.

There has been a growing concern over the past years that the relationship between science, technology and society should be better defined. Orpwood and Souke (1985), referring to a report made by the Science Council of Canada (SCC) in 1984, emphasized the need to teach science in relation to its societal and technological contexts. It is argued that science and technology which are taking an increasing part in our society cannot grow isolated from their social and political counterparts. The environmental crisis is directly linked with this issue. The SCC report suggests that the development of the students'critical thinking ability should help them understand the place of science and technology in social issues.

5. Summary

This chapter reviews contemporary concerns in science education. Three major levels of concerns were discussed: (1) at the discipline level educators have expressed the need to adopt teaching methods that favor the scientific approach (i.e. inquiry method, discovery method, independent group approach, etc.). The mode of instruction should also trigger students' enthusiasm and interest for science. (2) at the individual level, science curriculum should put more emphasis on the child's own development. (3) at the social level, the link between science, society and technology should be made clearer and an environmental awareness must be developed. The MEQ ecology curriculum recognizes these needs, but does not prescribe any particular teaching approach.

# CHAPTER III

## ADVOCACY FOR OUTDOOR EDUCATION

"As contemporary curriculum tends continually toward an emphasis on abstract knowledge, the need for holding onto concrete learning becomes increasingly important."

Donald and William Hammerman (1973)

# CHAPTER III

# ADVOCACY FOR OUTDOOR EDUCATION

## 1. Introduction

The purpose of this study was to assess the cognitive and affective values of outdoor-related experiences in order to substantiate whether they should be integrated into the Quebec ecology curriculum. The major areas of concern regarding outdoor experiences for science education were briefly summarized in chapter II. They included a concern for conveying a correct and sufficient representation of the nature and content of the discipline, a concern for the society, and a concern for the individual. Education, whether indoor or outdoor, should incorporate these concerns on the front line. With regard to outdoor education, how can it respond to the needs of students within each of these areas of concern? Chapter III tries to answer this question.

There exist a number of sub-themes within each area of concern mentioned. Table 1 summarizes these different sub-themes that educators have identified regarding outdoor education.

TABLE 1

Areas of Concern Regarding Outdoor Education

| | |
|---|---|
| A CONCERN FOR THE DISCIPLINE | -Collecting facts<br>-Assimilating concepts<br>-Learning through first-hand experiences, discovery, inquiry, critical thinking ... |
| A CONCERN FOR THE SOCIETY | -Socialization<br>-Democratic understanding<br>-Technological knowledge and understanding<br>-Environmental awareness |
| A CONCERN FOR THE INDIVIDUAL | -Recreation<br>-Self-realization |

(adapted and modified from Hammerman and Hammerman, 1973, p.14)

Each of these aspects will next be discussed in relation to outdoor ecology.

## 2. A concern for the discipline

(1) Overall cognitive learning. Public education seems to be seeking to give increased attention to the skills

associated with the construction of meaning and thought. Such skills might be referred to as the intellectual operations, i.e. the operations of the knowing process and of the achieving of the products of knowledge. Such skills are strongly emphasized in the ecology course. The MEQ promotes the scientific approach by focusing on the basic learning skills of the individuals. There are sequences in each module of the ecology document that promote not only training in observation, development of dexterity, use of reference material, and other physical skills, but also practice in finding solutions to problems through the use of logical reasoning, imagination, common sense, etc.

For many psychologists, activity is the basic ingredient of a theory of cognitive learning. Dewey adopted this concept as the basis for a philosophy of education that has dominated educational theory and practice since the 1920's. Learning, according to this psychologist, results from a problem situation, and consequently is dependent on each individual's needs, drives, and motives, as well as on the environmental situation itself. Learning results from the activities undertaken to resolve a problem situation.

It is commonly believed by enthusiasts of outdoor education that the outdoor setting especially lends itself to helping the individual expand his intellectual powers.

The outdoors has a strong quality, a quality of being real, alive, and in the process. One is actually involved in and learning about "what is". When proposing the integration of outdoor ecology activities into the biology curriculum, Reichert stated:

> "All biological principles come into play in an ecosystem. Here plants and animals are no longer static units for discussion and dissection, but living, interacting organisms. Students should view the outdoor labs not as recess from lecture or lab, but as an opportunity to investigate the living world as it really is."
>
> (Reichert, 1987, p.298)

The natural setting can make profound use of inductive teaching and learning. Here, observation is central, and offers limitless sensory data to the individual. Learning is individualized.

All the factors suggested as being conducive to developing cognitive learning (i.e. needs, motives, appropriate environment, etc.) are present in the outdoors. As Gaudin (1984), and Biggs and Tap (1986) suggested, it is the actual teaching method and organization that will or will not foster learning.

(2) Facts and concepts: According to the Ecology Curriculum of the Ministry of Education of Quebec (MEQ, 1983, p. 9), one of the goals of the ecology course is to

familiarize pupils with basic ecological knowledge. One approach to the acquisition of knowledge and information in this course is to have students make observations and collect data. This, in fact, constitutes the first step of the scientific method that involves a process approach.

The resources that are available in our schools for observation purposes vary from school to school. These include textbooks, models, preserved specimens, etc. but, as Asbaugh (1967) pointed out, opportunities for observation are even more plentiful and more diverse in the outdoors. This fact is perfectly illustrated by Sharp in his appropriately phrased remark:

> "Don't try to bring the whole world into the school. Rather, take the children out to where the world is."
>
> (Sharp, 1952, p. 19)

Many researchers are encouraging the actual gathering of information as data based on out-of-school experiences (Brenman, 1967; Asbaugh, 1967; Postlewait, 1980; Bicak, 1982; Penik and Yager, 1986a). McCormack speaks of the recommendations of the National Science Board Commission in the USA (N.S.B) on Precollege Education in the following terms:

> "According to the Commission, science instruction should produce ability to formulate questions about Nature and seek answers from observation and interpretation of natural phenomena."
>
> (McCormack, 1984, p.199)

Another good point in favor of supporting the incorporation of outdoor activities into an ecology course is that the facts collected by students through their own observations appear more real. The information is more concrete and therefore bears more significance for the learner. The higher level of relevance can be produced and demonstrated by means of a more practical experience which requires multi-sensory observations. The learner does not only learn through visual observation, but also through the senses of touch, smell, hearing, and even taste, rendering a better assimilation of the facts. Cultice also emphasized this point in the following example:

> "Reading about a bakery will involve only seeing -other sensory experiences can only be imagined. Conversely, a field trip to the bakery will involve every motor sense of each child. The child may smell, touch, hear, and possibly taste, as he progresses through the bakery."
>
> (Cultice, 1967, p.13)

With a case such as the one mentioned above, one can imagine how much easier it is to develop the concept of a bakery and assimilate the related facts as a result of the actual visit. With such an experience, retention of the concept probably is fostered as well, and there is a good chance that the visit to the bakery is imprinted in the learner's mind for the rest of his life. In the same way, understanding of natural processes and their interactions is enhanced through ecological field work (Hale, 1986). The retention value of outdoor experiences has been mentioned by various authors, particularly by Younghusband (Biggs and Tap, 1986) who emphasized the importance of memories and lasting impressions in his comments on illiterate prospectors.

The development of ecological concepts by students from various facts is not always an easy task, but comprehension seems to be enhanced as a result of exposure to concrete outdoor experiences. Also, the description of some concepts in an outdoor setting sometimes necessitates long explanations and a large number of technical terms to ensure their complete understanding: in a field trip situation sometimes this task can be facilitated. Sharpe stresses this point in the following story:

> "I remember well a family who visited us in Maine.They lived a thousand miles (1600km) inland, and it was their first visit to the ocean. Naturally, on arrival they wanted to go down to the shore: I thought of the many things I had to tell them: how plants and animals survive in the pounding surf, what their enemies are, how each finds food and how they reproduce in the sea. Where should I begin? When we reached the shore they only had one question -'Is the ocean really salty? ' They scooped up a handful of water and answered their own question."
>
> (Sharpe, 1976, p.445)

(3) <u>First-hand experience</u>: For many years psychologists and educators have insisted that effective learning takes place only where it can connect with direct experience (Dewey, 1938; Piaget, 1964; Kilpatrick, 1963; Carlson, 1973; Thier, 1981). School buildings are still being designed to bring information into the classroom to be learned. It has been reported that schools usually do not teach a relevant curriculum; when they do, they fail to teach the child how he/she can relate this learning to his/her life outside of school (Glasser, 1969).

Researchers such as Sharp (1952), Hammerman and Hammerman (1964) and Brenman (1967) have emphasized the effectiveness of using our natural environment in schooling. Hug and Wison have said:

> "Learning is stimulated and new interests are aroused by providing intriguing first-hand experiences. Such experiences penetrate more deeply and are longer lasting than vicarious ones."
>
> (Hug and Wilson, 1965, p.1)

Thus, it is possible that the amount of school time needed for reteaching and for review could be lessened. The new interests acquired from direct experiences in the environment bring the learner to broaden his concepts, to investigate many sources of information, and to examine new areas of knowledge. An alteration favoring direct experiences in the ecology curriculum could become evident in children as a result of their participation in outdoor education experiences. Reichert (1987) has recommended that ecology 'hands-on' experience be extended to the local environment.

In this regard, the integration of outdoor experiences into the ecology course is facilitated when we look at the following goal of the Ministry of Education of Quebec:

> "To provoke in the students a type of learning conducive to integrating the acquisition of knowledge to personal experience."
>
> (Ecology Document, 1983, p.7)

(4) The scientific methodology: The instructional approach found in the Ecology document (p. 14) is designed to introduce the pupil to the steps of the scientific

method. Authors, such as Postlewait (1980), also encourage the use of scientific methods in teaching. As mentioned earlier (see chapter I, p. 15), studies conducted by Kennedy and Heckman (1981) have identified the failure of traditional science teaching in helping students develop a scientific attitude.

Asbaugh (1967) and Brenman (1967) have suggested outdoor activities in ecology using the scientific approach, and Hug and Wilson (1965) have proposed various outdoor experiences (exploratory, discovery, and inquiry methods) that make use of the scientific approach. Blackwood has emphasized the need to use a discovery approach in planning field activities:

> "The great value of the discovery approach, then, is that pupils have real experience in using the methods of scientists."
>
> (Blackwood, 1966, p. 7)

The effect of field studies on the learning of the methodology of science has been investigated by several researchers such as Riban and Koval (1971). These authors tried to evaluate the educational benefits for the students of such experiences and found positive results when they compared an experimental group with a control group. Chrouser (1975) also compared outdoor and indoor laboratory techniques in training teachers of elementary biology. The following conclusion was reached by him based on his investigation. A biology course for prospective elementary school teachers which emphasizes field experience during much of the laboratory time is more effective than a course using only the indoor laboratory in helping students to achieve understanding of science as a process. Similar results were obtained by Harvey (1951).

These findings underline once again the need to integrate well-planned outdoor laboratory activities into the existing ecology program.

3. A concern for the society

(1) Environmental awareness.

Environmental protection is a growing concern in our society. This issue should now be discussed in relation to the outdoors.

William Chrouser, in his comparative study of indoor and outdoor laboratory techniques in teaching biology, made the following observations:

> "Those in the outdoor group sensed a deeper understanding of the individual's role in his environment and in his society and that the environment must in turn be "fit" for a society. This awareness results in an understanding of a need for conservation practices. By the end of each course the outdoor group showed a much deeper sense of group loyalty and unity than the indoor group."
>
> (Chrouser, 1975, p. 46)

The major values mentioned by Chrouser, i.e. a concern for the environment and a concern for one's peers, constitute important values in the ecology course. Two of the major goals of this course directly pertain to these values:

> "*to encourage the pupil to develop positive attitudes toward himself, other people, and his environment;
>
> *to enable the pupil to perceive his environment in a more realistic way and with greater awareness and commitment."
>
> (Ecology Document, 1983, p.9)

The concern of the MEQ for the world's environmental problems has become a major theme in the ecology course. This issue is world-wide at the present time, and numerous authors, educators, and environmentalists are stressing the need for an appropriate environmental education (Forster, 1961; Stotler, 1967; Keown, 1984).

There is a growing belief among educators that effective awareness techniques can most effectively be inculcated in learners in an out-of-school situation. More traditional classroom approaches will need to be rejected because they tend to ignore the community and the real world (Penick and Yager, 1986b). In this regard, Chrouser has written:

> "The environment must in turn be "fit" for a society and individual. There is, therefore, no substitute for a field laboratory in this kind of preparation at a time when awareness and understanding of the environment may mean individual and social survival."
>
> (Chrouser, 1975, p.46)

The environmental crisis raises the need to understand the connection between science, technology and society. For Charles (1986), one way to help in grasping this link is also through outdoor activities. For him, direct experience with the environment should bring an ecological understanding of this whole issue. In one of his recommendations to this problem, at a conference held for science teachers in Ohio, he said :

> "Literally, go outside whenever you can. There is nothing more powerful than first-hand experience with the living world."
>
> (Charles, 1986, p. 23)

(2) <u>Other social values</u>.

Other social values of outdoor education are important too (Hammerman & Hammerman, 1964). Members of groups learn that each person has something unique to contribute. Group work becomes more efficient through practice in formulating objectives, planning, dividing duties, and sharing responsibility for the results. Mantle and Heath (1986), in commenting on the value of ecology fieldwork, also supported this statement. Children's needs for adventure are satisfied in a socially acceptable way. During longer field experiences of a few days or weeks, students meet the more subtle problems involved in group living, problems that are connected with the unselfish and unbiased consideration for others, and problems involved in fears and prejudices. Thrown together into a single group with others who have different backgrounds, social, racial, economic, religious, etc., students learn good and valuable lessons very quickly and in a very natural way. Lessons in democracy do not have to be investigated and assigned by the teacher. Various authors have insisted on the social value of field trips (Hug and Wilson, 1965; Cultice, 1967; Hammerman and Hammerman, 1973; Krepel and Duvall, 1981; Knapp, 1989). Meyer and Rao (1984) have selected unpublished papers in Asia on the social virtues of out-of-school science. For most of the authors of this collection of articles, the outdoor was a major factor in fostering the development of balanced human personalities.

4. <u>A concern for the individual</u>

According to Biggs and Tap (1986), it has been suggested by the National Science Association's Horizons Committee that individuality must be taken into account in future science curricula. Most of the attitudes promoted in the MEQ's ecology course do focus on the individual. They are expressed as values in the form of feelings, beliefs, convictions, or as a continuing willingness to behave in a conscientious way toward living beings and things in the environment. The curriculum encourages the creation and presentation of activities that are meaningful to the student, stimulate curiosity, arouse interest and motivation, and promote self-confidence.

Yager reports that present science courses fail to trigger students' interest:

> "Not only do students lose interest in science as they progress in school, but students also are less interested in science after a science course than they were at the beginning of the course"
>
> (Yager, 1986, p.145)

It has been suggested by many educators that science taught outdoors is the solution to these problems (Kahle, 1976; Dirienzo-Skalecki, 1981). For these authors there seems to be something about the out-of-doors which they believe aids in promoting interest in subject matter. Chrouser made the following comment:

> "An individual's curiosity is aroused when he is confronted with the outdoors in a learning situation and curiosity is important in the problem-solving approach."
>
> (Chrouser, 1975, p.47)

Outdoor activities share many characteristics that foster self-realization of the child (Knapp, 1989). First of all, personalities grow in the relaxed environment in which teacher and pupil see each other as people. The quiet child dares to speak; the overly talkative one begins to use more judgement in this phase of his behavior. The child with practical intelligence earns recognition from those who are more scholastically gifted, and thus gains greater self-respect. Teachers and children begin to know each other in a way that produces mutual esteem. Field trips are, therefore, a proven method of altering or formulating desirable attitudes of courtesy, patience, sportsmanship, and cooperativeness on the part of the student.

For Kilpatrick, outdoor values meet three main specific aims for education:

"-help each boy or girl to grow into more adequate selfhood or personality
-help each one to enrich his own life by upbuilding himself
-help each one to grow into more adequate social relationships."

(Kilpatrick, 1942, p. 15)

---

In conclusion, outdoor education is held in high esteem by educators and its potentiality seems to be even greater for topics such as ecology.

5. Summary

This chapter reviews opinion literature on the value of outdoor education. The review was not meant to be exhaustive. Three aspects were considered. (1) the advantages of the field experience at the discipline level were: (i) the data collected in the environment appeared more concrete and relevant, (ii) the five senses could be involved in the gathering of meaningful information, (iii) retention of concepts was facilitated, (iv) comprehension was enhanced as a result of exposure to concrete outdoor experiences, (v) the outdoor environment offered the possibility of organizing 'hands-on' experiences and facilitating the scientific approach, (2) the advantages for society were: (i.) social development was enhanced through a long outdoor experience and (ii.) environmental awareness was facilitated with an out-of-school situation and (3) the advantages for the individuals were (i.) outdoor activities fostered self-realization and (ii.) aroused interest and motivation.

The MEQ ecology curriculum sees in the outdoor experience a valid teaching approach, although no emphasis is put into this issue.

# CHAPTER IV

## REVIEW OF THE SCIENTIFIC RESEARCH ON OUTDOOR ECOLOGY ACTIVITIES

"We know too much and feel too little. At
least, we feel too little of those
creative emotions from which a
good life springs. In regard to
what is important we are passive,
where we are active it is over
trivialities."

Russell (1921)

# CHAPTER IV

# REVIEW OF THE SCIENTIFIC RESEARCH ON OUTDOOR ECOLOGY ACTIVITIES

## 1. Introduction

The purpose of this study was to assess the cognitive and affective values of outdoor ecology-related experiences in order to substantiate whether or not their integration into the Quebec Ecology Secondary I Curriculum might be beneficial for high school students. An attempt to identify the educational needs in science, and, more particularly, in ecology, was first presented in this monograph. The second part consisted of showing how, in theory, outdoor ecology activities could respond to these educational needs. This Chapter, taking a more practical approach, tries to determine what, in fact, outdoor activities have been able to achieve. As a result, this section reviews the research findings that evaluate the relative cognitive and/or affective value of outdoor experiences in the subject area of ecology.

The selection of the research studies took into account the following criteria:

(1) Choice of research papers not limited to ecology. A definition for ecology as used in the context of this monograph was presented in Chapter I (see p. 10) and defined as a specialized branch of the biological science which focuses on interrelationships between living things and non-living things in the natural environment. With such a broad interpretation, the teaching of ecology calls for the integration of various related disciplines such as zoology, botany, earth science, geography, etc. For Hale (1986), field studies in ecology should incorporate various academic subjects. A study of the MEQ ecology curriculum's learning objectives supports this view. Table 2 presents examples of disciplines related to cognitive objectives found in the Ecology Document.

TABLE 2

Some related disciplines found in the MEQ Ecology Curriculum

| DISCIPLINES | LEARNING OBJECTIVES* |
|---|---|
| Botany | (2.3) To explain, in a simple manner, the function of chlorophyll. |
| Earth Science | (1.2.8) To determine the percentage of mineral salts in soil. |
| Environmental Studies | (1.4) To identify the harmful effects that various polluting agents suspended in the air or in water can have on man's health. |
| Geography | (1.6.1) To name some of the natural phenomena which can cause a windfall. |
| Zoology | (3.5) To identify the different parts of an animal's body. |

*(MEQ Ecology document, 1983, pp. 18-46)

As a result, all the studies which utilized themes found in the MEQ Ecology curriculum, Secondary I, but which were not directly on ecology, were also included in this survey.

(2) No restriction on field studies'designs.

The studies on cognitive and/or affective values of outdoor ecology (or related disciplines) activities took one of the following approaches:

i) Comparison of two modes of instruction, one indoor, the other outdoor.

ii) Comparison of two modes of instruction; the two being outdoor.

iii) Comparison of pre-test and post-test results on a single field activity.

iv) Comparison of various combined modes of instruction (indoor/outdoor)

(3) Subjects had to be grade school children ranging from the fifth to the twelfth grades, or teachers involved in these grade levels. In the province of Quebec, the ecology course is taught to Secondary I students, with some ecological principles also introduced at the elementary levels from the Natural Science course (MEQ Natural Science document (1984)). In other provinces and in the United States, the age at which ecology is taught varies a great deal, and, as a consequence, so does the subjects'age level used in the research studies.

(4) Research papers had to present details of their experimental approach on the following items:

i.) Area and date of study

ii.) Number of subjects and type of population iii.) Source and nature of evaluative methods

iv.) Teaching methods

v.) General learning content

vi.) Type of statistical analysis

vii.) General objectives

(5) Only North American studies were accepted in this review.

The research papers reported in this Chapter are listed by chronological order, and by subject areas.

(1) On biology (ecology not being a strong emphasis), they are:

(i) A comparative study of two modes of instruction (an indoor and an outdoor method) on the learning achievement of Secondary II students by Johnson (1977)

(ii) A comparative study of the cognitive effect of two laboratory approaches (an indoor and an outdoor method) upon prospective elementary teachers by Chrouser (1970).

(2) On Earth Science, they are:

(i) A comparative study on the effect of two laboratory techniques (indoor and outdoor method) in the achievement of individual concepts of grade 8 and 9 students by McNamara (1971).

(ii) A study of the effect of three modes of instruction (indoor, outdoor and indoor/outdoor settings) on the cognitive achievement of fifth grade students on the topics of soil, temperature and trees by Wise (1970).

(3) On ecology, they are:

(i) A study on the influence of field instruction strategies on high school students' understanding of selected concepts by Lisowski (1987).

(ii) A comparative study of outdoor and indoor instruction on student perceptions of classroom climate and on achievement at the grade six level by Holly (1982).

(iii) A comparative study of an indoor/outdoor laboratory method in a secondary Nigerian school by Oloke (1981).

(iv) A study on affective changes of grade five students toward environmental education as a result from their participation in an outdoor ecology program by Zwick (1977).

(v) A comparative study of two methods of instruction (an indoor and an outdoor approach) on the learning of concepts of grade five students by Hosley (1974).

(vi) A study of the effectiveness of an outdoor education program in biology and ecology on fifth and sixth grade students' ability to identify living organisms and relationships between them by Kaplan (1974).

(vii) A study on the effect of an outdoor experience on sixth grade students' cognitive understanding of concepts by Slater (1972).

(viii) A comparative study on the effectiveness of outdoor, indoor and combined indoor/outdoor settings in evaluating cognitive learning of fifth grade students by Howie (1972).

(ix) A comparative study on the effect of two field methods (independent work and discovery approaches) to foster cognitive learning and bring about affective changes in high school students by Buerstatte (1968).

(x) A comparative study of the value of outdoor and indoor instructional methods in attaining cognitive and affective changes of Secondary I students by Bennett (1965).

(4) On Environmental studies, they are:

(i) A comparative study of the cognitive and affective effects of outdoor, indoor and combined outdoor/indoor settings on conservation and pollution upon 10th grade students by Peck (1974).

In the first section of this chapter, empirical studies are summarized in the order previously presented. The second part analyses the findings and discusses the value of reviewing scientific papers on outdoor ecology.

2. Research papers.

(1) Biology

(i) JOHNSON, G. (1977)

Johnson undertook a comparative study of the learning achievement of selected portions of biology taught indoors (using live and preserved specimens) and outdoors (using nature as a classroom). The study was done in the fall season of 1975 for a ten week period. Four grade eight classes (28 students each) from an anonymous school of the Pittsburgh Public School System, Pennsylvania, were participating in this experimental research. The four classes were randomly assigned to the following treatments:

1) Zoology and botany taught indoors only

2) Zoology and botany taught outdoors only

3) Zoology taught indoors and botany taught outdoors

4) Zoology taught outdoor and botany taught indoors

For indoor instructions the groups utilized teachers'notes and drawings, live and preserved specimens, selected films and filmstrips and terrariums. For outdoor instructions the groups utilized the outdoors in the wooded area behind the school, visits to the Pittsburgh Aviary, the Phipps Flower Conservatory, and the Pittsburgh Zoo. All instructions were given by the researcher and monitored periodically by science supervisors from the Pittsburgh Public School Supervisory Staff. In both the control and the experimental groups, the students were taught the divisions of the plant kingdom and their superficial characteristics, basic structure of plants and their functions and ecological relationships between plants and other organisms, selected phyla that make up the kingdom Animalis, definitions of some zoological terms and ecological relationships between animals and other organisms.

The evaluation instruments were developed by the investigator and consisted of two subtests, botany and zoology, and a biology final examination; all were testing cognitive achievement of concepts. The rationale for this evaluative approach is based on an experimental design which was adapted from the Posttest Only Control Group Design described by D.T. Campbell and J.C. Stanley (1969). The construction of the instruments were based on six professionally designed tests (see references given p. 52 of Johnson's monograph). Reliability of the final test was calculated by means of the Kuder-Richardson Formula (KR21= 0.92) and its validity for eighth grade pupils was asserted by three professors of the Biology Department of Clarion State College, Clarion, Pennsylvania.

Statistical analysis of the data has been treated in order to compare any differences in achievement due to modes of instruction, sex of the participants, or interaction mode of instruction/sex.

Results indicate that learning achieved by the outdoor and the indoor groups was similar, and both of these groups achieved better than the other two groups which received the mixed modes of instruction. On the overall results, it can also be concluded that males and females performed at the same level.

(ii) CHROUSER, W. H. (1970)

His work was designed to investigate and compare the effects of two laboratory approaches (indoor vs outdoor teaching techniques) in biology upon prospective elementary teachers in their understanding of the social aspects of science, achievement in selected biological principles, understanding of science as process, and ability in critical thinking.

The subjects were students enrolled in the biology course designed for prospective elementary teachers at Colorado State College during the spring and summer seasons of 1969. Twenty-eight students were enrolled in Science 203 for the spring quarter and 12 students registered for the same course for the summer quarter. Each of these two classes was divided into two groups: a control group (indoor lab) and an experimental group (outdoor lab). No indication on how the group was divided is given by the author.

The course consisted of two hours of lecturing per week and two hours for laboratory per week. Materials covered were identical for each group (indoor and outdoor groups). Methods of instruction consisted of discussion, inquiry, color slides and lectures . Textbook used was :Nelson et al (1967) Fundemental Concepts of Biology, Freeman and Comp., San Francisco. The indoor and outdoor laboratory approaches are not described by the author.

"The Test on the Social Aspects of Science" was used to measure gain in understanding of the social aspects of science. This test consisted of 52 statements each of which was related to (1) the interaction of science and technology with society ,(2) the scientific institution as an internally-regulated institution and (3) social, economic and political problems produced by the changes in society resulting from advanced science and technology. The students responded on a five-point scale ranging from 'strongly disagree' to 'strongly agree'. The author made reference to two sources to assess the quality of discriminating power and reliability of this test (r=0.71).

" Methods and Procedures of Science: An Examination" was used to measure gain in understanding of science as process. This test was designed by a volunteer committee under the direction of Dr. John H. Woodburn and the National Science Teachers' Association. This test placed major emphasis on the biological sciences and was designed to measure the processes of science and logic used in scientific manipulation. According to Woodburn, test reliability is 0.8 (from a letter sent to the author).

"The Watson-Glaser Critical Thinking Appraisal" was used to measure gain in critical thinking ability. According to Chrouser, the validity of this test rated high on logical correctness of the key and in content. Reliability = 0.9.

"Understanding of Selected Biological Principles: An Examination" was used to measure gain in the understanding of the biological principles used in the study. The test consisted of three items per principle chosen from the teacher's manual and the student's study guide . The data were obtained by giving each of the instruments as a pre-test and post-test. The content and curricular validity were assured by items being related to each principle chosen from a text- related source.

Each of the four instruments was given as a pre-test during the first class meeting and first lab session. Post-tests of each instrument were given during the second to the last class period.

The Chi square analysis of scores on Test on the Social Aspects of Science showed significant differences in favor of outdoor education in each of the three areas tested, namely, science and technology as they interact with society, nature of the scientific enterprise, and social responsibilities of science and scientists.

Analysis of covariance was used to analyse the gain in understanding of selected biological principles, understanding of science as process, and critical thinking ability. The F-tests for the significance of difference between adjusted means for the indoor and outdoor groups showed a significant difference at the 0.05 level of confidence in the specific biological principles involved in the laboratory activities and in the biological principles in general, and critical thinking showed no difference.

(2) Earth Science

(1) MC NAMARA, E. S. (1971)

The effectiveness of learning earth science through field experiences was probed by McNamara, whose study involved a comparison of the indoor laboratory technique and the field laboratory approach. In his comparative study, the investigator analysed the overall achievement of individual concepts of 8th and 9th grade earth science students. The study was conducted at East Ridge Junior High School in Ridgefield, Connecticut. The outdoor activities were held next to this school.

Fifteen science classes (13 groups of grade nine students and two groups of grade eight students) of approximately 25 students each were randomly and evenly divided into control (indoor laboratory group) and experimental groups (outdoor laboratory group). Both the indoor and outdoor groups studied Unit One of the Earth Science Curriculum Project textbook (Earth Science Curriculum Project (1967). Investigating the Earth. Boston, Houghton Mifflin Co.) for ten weeks. Outdoor investigations were developed to correspond with their respective indoor investigatory concept for Unit One of the textbook. The outdoor laboratory investigations were analysed for their similarities with the indoor laboratory investigations by 10 secondary and collegial science teachers.

The study consisted of lab sessions and a prepackaged instructional kit. All groups received indoor instructions according to the prepackaged instructional materials. Only the experimental group undertook lab activities totally outdoors.

The overall achievement was assessed through the ESCP Achievement Test (American Geological Institute (1965). ESCP Achievement Test 1. New York, Psychological Corp.); the evaluation instrument used for measuring critical thinking was the Cornell Critical Thinking (Ennis, Robert H., and Jason Millman. Cornell Critical Thinking Test (1961). New York, Cornell University.); and a "concept test" evaluated achievement on individual concepts. The latter was constructed by the investigator to determine if significant differences existed between the achievement of individual concepts between the groups experiencing the laboratory investigations in the indoor environment and the groups experiencing the laboratory investigations in the outdoor environment. It consisted of six to ten questions from each of 14 concepts chosen from the investigations (questions selected from various sources). Content validity was measured by the science staff at East Ridge Junior High School. The KR-20 reliability test was performed for each concept test and individual concept test (R= 0.88). All students were pre- and post-tested with each of the test instruments except for the concepts test which was used only as a post-test.

Analysis of the results indicate that the outdoor experimental group scored significantly higher on some individual concepts (rocks, minerals, latitude, maps, magnetic field) and on critical thinking. However, the environment in which the lab activities were held had no significant influence on the overall achievement of the students. According to the author, these results indicated that both environments were equally effective in promoting overall student content achievement in earth science although some specific concepts were taught significantly better in the outdoor environment.

(11) WISE, R. C. (1970)

Wise also made a comparison of the effect of indoor, indoor/outdoor and outdoor settings on the learning of three topics in science: soil, temperature and trees. Three aspects of the cognitive domain were analysed: comprehension, acquisition of knowledge and subsequent observation made by the student in the outdoor settings.

The experimental design included a pre-test, post-test (immediately after the study period) and post-post-test (three weeks after the study period), but no control was used. Subjects in this study were 261 fifth grade students taken from three classes randomly selected from each of three schools: Dr. Robert F. Nicely Elementary School from the Greater- Greensburg Salem school district, Fort Allen and West Hempfield Elementary Schools from Hempfield School district, Pennsylvania. Students and teachers were also randomly assigned to the treatment groups.

All treatments, the indoor, outdoor/indoor and outdoor were similar in the following respect: time allotment (one week for each topic and 40 minutes for each lesson), period of the day the students were being instructed, teaching procedure and materials. The direct outdoor experience group used materials found in their natural outdoor context while the other two groups used only some natural material brought into the classroom.

The evaluation instrument was developed by the investigator and consisted of an achievement test of 60 multiple-choice questions. Part I and part II of the achievement test were designed to measure recall/knowledge and comprehension, respectively. The same instrument was used for pre-, post- and postpost testing. The achievement test was submitted to the Kuder-Richardson 20 Reliability formula in order to measure its degree of internal consistency. Results indicate a consistency level of 0.90.

Analysis of the achievement test results indicated no significant difference between the pre-test scores of all the groups.

Based on the post-test scores, the outdoor group's results were significantly higher than those of the other two experimental groups on knowledge/recall and comprehension.

(3) Ecology

(i) LISOWSKI, M. (1987)

This author studied students' conceptions of selected ecological concepts and the influence of field instruction strategies on students' understanding and retention of these concepts.

The sample consisted of three independent groups (n =?) of Secondary students who attended a seven-day marine science field program. Instruction on ecology comprised one part of the field program.

The investigator developed the Student Ecology Assessment (SEA) instrument in order to evaluate the students' understanding of ecological concepts. Students responded to the SEA instrument prior to, during and four weeks after the field program. The concept strand subscores and total scores from each group's pre-test, post-test, retention test, adjusted gain, and retention adjusted gain results were subjected to multiple regression analyses.

Analysis of the results indicates that the three groups of students scored significantly higher in post-test total scores on the SEA instrument. Results on the retention test are also positive. Gains in students' scores in the major concept strands were related to the instructional emphasis given to those areas.

(ii) HOLLY, J. C. T. (1982)

Holly compared the effectiveness of two modes of instruction, one indoor and the other outdoor, in ecological studies on grade six students for achieving particular cognitive and affective objectives. The outdoor method of instruction consisted of frequent teacher-student planning, teaming, inquiry sessions, total hands on experiences and working together as a group to solve problems and answer questions. The indoor method was mainly teacher-centered, consisted of little or no student planning, involved extensive writing on the board and no teamwork. 'Hands-on' experiences were limited only to teacher demonstrations.

Subjects in the study numbered 894 grade six students of a large metropolitan school district in Mississippi. The indoor group (448 students) met four times per week for 45 minutes for a six week period. The outdoor group (446 students) met once a week at the school's district Environmental Education Outdoor Classroom site for a period of 180 minutes and were taught inside and outside.

The investigator used the Classroom Environmental Scale instrument (See Moos, Rudolph (1974). The Social Climate Scales: An Overview. Psy. Press, Dalo Alto. p. 31) as a measure to evaluate perception by the students of the social climate within the classroom. The test contains 90 true-false items on nine subscales that measure distinctly various aspects of the social environment (eg. the involvement, affiliation, teacher support subscales measure relationship dimension). The cognitive achievement of students on the ecology unit was evaluated through an instrument called the Ecology Unit Test and developed by the researcher. This test consisted of 24 multiple-choice items covering general concepts in ecology and designed to measure recognition of concepts, application of concepts and synthesis. Content validity was determined by four university science instructors. Reliability was established through a test-retest method (R=0.85). The affective and cognitive instruments were both administered as pre- and post-tests.

An analysis of covariance was used to compare affective and cognitive achievement of both methods and the F-test was used to determine the effectiveness of the two methods.

Results indicated that, overall, perceptions of classroom climate are influenced when either method of instruction is used. However, the outdoor group had significantly more positive perceptions of their classroom climate on several (Involvement, affiliation, teacher support, competition, order and organization, rule, clarity and innovation) of the nine subscales of the CES test.

(iii) OLOKE, L.O. (1981)

This study was designed to determine the effect of two instructional methods on the cognitive achievement in ecology and on the development of attitudes toward the environment of grade eleven biology students. One method consisted of a traditional approach based on the national curriculum. The other method was a modified laboratory approach utilizing both indoor-outdoor ecology investigations.

The study was conducted at the Federal Government College in Kano, Nigeria, during a ten week period in the winter of 1981. This school was chosen because its students come from different areas of the country and because they are randomly admitted and placed in classes. Two classes consisting of 31 and 34 students served as the control group (traditional method), and two other classes consisting of 33 and 36 students composed the experimental group that was exposed to an indoor-outdoor laboratory approach. Each class met for four periods of 40 minutes each every week. Two periods were devoted to theory and another two to laboratory activities. For the traditional approach, classes were taught mainly by lecture; textbooks were used as the primary source of information, including photographs and diagrams. Laboratories consisted of examining specimens and viewing films. For the experimental indoor/outdoor approach, students were required to collect, record, analyse and interpret data. The oudoor laboratories focused on various ecological concepts. For both methods the course content included biosphere, ecological habitats, periodic changes in the environment, biography, soil and water conservation, and forest and wildlife resources.

For his research, the investigator developed an Ecological Concept Achievement Test that consisted of a pre-test and post-test examination which he administered to both treatment groups. The test contained 50 questions (10 true or false, 10 matching questions, 11 completion and 13 multiple-choice questions) of various cognitive categories (analysis, synthesis, facts). This test was examined for its content validity by the science education staff from the University of Northern Colorado. Its reliability (using the Spearman-Brown formula) was calculated (R= 0.82) and the balance and coverage of objectives were assured through the use of a two-way axis chart. The Billings' Environmental Assessment Instrument was used to measure differences in environmental attitudes. This test also was divided into a pre-test and a post-test. The test consisted of 46 yes/no items. It was used for the first time in Billings, Montana for environmental studies and was constructed from a curriculum guide produced by the United States Bureau of Land Management in 1975 (see Zwick, 1977).

The results of the cognitive achievement test showed a statistically significant difference between the means of the control and the experimental groups indicating that the indoor/outdoor laboratory method of teaching ecology was more effective in producing cognitive gains than the more traditional approach. There was no significant difference, however, between the experimental and control group means on the environmental attitude test.

(iv) ZWICK, T. T. (1977)

This author conducted a study on changes in students' affective behavior toward environmental education and environmental values resulting from their participation in an outdoor ecology program.

Subjects consisted of 160 fifth grade students, 40 from each of two high socio-economic schools (Miles Avenue and Rose Park) and from two low socio-economic schools (Washington and Ponderosa), within School District 2, Billings, Montana. Random methods were used to select an experimental and control group. Each of these groups was composed of one high and low socio-economic school. The experimental group received the environmental instruction and attended the AH-NEI environmental field experience. The latter is an environmental education study area near Billings, Montana. The program has 10 major objectives, most of them are related to conservation and man's role in nature, and are directly linked with ecology. It is based on 'hands-on' learning experiences and encourages decision-making. The control group received the environmental instruction, but did not participate in the AH-NEI field program.

The affective attitudes and values of the students were determined by administering two instruments: (1) the Billings Environmental Attitude Assessment Instrument (BEAAI). The BEAAI is an attitude assessment test designed by the investigator and constructed from the affective behavioral objectives (attending, responding, valuing, organization and characterization by a value) listed in the "AH-NEI" Curriculum Guide. The test consists of 46 items expressed as negative statements and where students' responses to the statements are indicated on a scale of 1 to 5 (from least to most positive). The BEAAI was validated by a panel of judges who possess an expertise in the affective domain and in environmental education. Reliability of the BEAAI was determined through a pilot study done in 1976 at Greely, Colorado (KR-21= 0.9). (2) the second instrument is the Check List of Observed Behaviors (COAB), a list of 12 values and behavioral attitudes extracted from the AH-NEI Curriculum Guide. It was developed to evaluate the students' behavior to selected environmental values found on the BEAAI. The method of evaluation consisted for the teacher to observe the students' actions towards values and attitudes expressed on the COAB and to rate the actions as frequent, occasional, seldom or never. The students' attitudes and values expressed on the BEAAI were then statistically correlated to the actions of those of the students expressed by the COAB.

The results of statistical analysis of the data collected revealed that the experimental field group showed a significantly more positive change than the control group.

The students from low socio-economic schools scored significantly higher than those from the high socio-economic schools.

(v) HOSLEY, E. (1974)

Hosley was interested in assessing the relative value of two different strategies for teaching ecology: a laboratory (classroom) instruction using the Audible Multi-Imagery (AMI) technique, and field experiences instruction. The AMI technique consisted of a simultaneous projection of two or more images (slides), coupled with a sound presentation (audio tape). The field treatment bore a special meaning for the author since a woodland scene painted on a large board was utilized along with animal cutouts; all of this artificial material being placed outdoors.

Subjects in the study were 100 fifth grade students randomly selected from 400 students currently participating in the Prince George's County Public Schools' Environmental Education Program, College Park, Maryland. His sample was comprised of a control group (25 students) which received no instruction prior to testing, an indoor group (25 students) which attended the AMI session prior to testing, an outdoor group (25 students) and a combined AMI/outdoor group (25 students). The instructional unit developed to serve as a basis for comparison of the treatments was structured on the balance of nature concept and specified ten learning outcomes according to Bloom's Taxonomy of Educational Objectives: Cognitive Domain. The same objectives and concepts were developed in both methods.

The instrument used to measure learning of environmental concepts was made by comparing each group's performance through a retention test. This test, developed by the investigator, consisted of 20 multiple-choice questions related to concepts in ecology (food cycle, energy cycle, nature balance, etc.). This test, representative of all material taught by both methods, was given to all students after completion of instruction. Content validity of such a test was assured through the building of a table of specifications which specifies the sample items to be used and identifies the subject matter topics and behavioral outcomes to be measured. Test reliability was measured by administrating the test to two pilot groups of students under similar conditions. The reliability coefficient determined by the Kuder-Richardson Formula 21 was found to be 0.69. No pre-test design was utilized by the investigator

Results indicate that the combined group scored significantly higher than the other groups, and that all experimental treatments' scores were significantly higher than those of the control.

(vi) KAPLAN, J.P. (1974)

Kaplan has reported his experimental research on the effectiveness of an outdoor education program in biology and ecology. The ability to recognize and identify living organisms and relationships between them was the point of interest in this study.

The study was undertaken during the spring of 1973 at the Outdoor School of Pennsylvania State University (located near State College within the University's experimental forest area). The subjects participating in the study were 53 fifth grade and 54 sixth grade students attending elementary schools within the State College Area School District. The sample was comprised of one outdoor experimental (52 students) and one indoor control (55 students) group. The experimental group (one fifth grade and one sixth grade class) received regular classroom instruction covering the same material as that of the control group.

The evaluation instrument was developed by the investigator and administered to both groups as a pre-test and post-test. The ability to identify relationships and the ability to recognize living organisms were measured separately so that each student received two scores. The test consisted of a picture depicting a number of plant and animal species indigenous to the Stone Valley area (where the outdoor school is located), and interacting in a number of ways. The students were asked to write down anything they observed in the picture (plants, animals and relationships between them).

Analysis of the results indicated that all post-test scores (including those of the control) were significantly higher than the pretest scores. However, no significant difference was noted between the indoor control and outdoor experimental groups in their ability to achieve some cognitive educational objectives.

(vii) SLATER, D.P. (1972)

Slater's investigation was concerned with the effect of an exploratory outdoor experience on the cognitive understanding of specific ecological concepts (adaptation, change, and interdependency in ecological communities).

Subjects for the study were 11 boys and 9 girls of a sixth grade class from lower socio-economic backgrounds.

Students participated in three pre-trip sessions which focused upon ecological communities. The study consisted of determining changes in the students' cognitive understanding of concepts before and after a one day field trip. Albuquerque Public School's Exploratory Field Trip consisted of an outdoor experience at the Environmental Education Laboratory located in the Sandia Mountains near Albuquerque, New Mexico. The outdoor experience involved the exploration of three ecological communities prior to the field trip.

The mechanism used to measure changes in cognitive understanding consisted of taping classroom dialogue of each first half-hour of three class periods preceding the outdoor activity and three class periods following the field trip and, then, analysing the content of the tapes by means of the Florida Taxonomy of Cognitive Behavior instrument (Brown, Robert B.(1967). Florida Taxonomy of Cognitive Behavior. Mirrors for Behavior, Philadelphia: Research for Better Schools). This instrument consists of 55 items which describe cognitive behavior that can be shown by both pupils and teachers in classroom situations. The observer's task is to identify and record these behaviors as they occur within specific time periods. An observer listened to the tapes and classified the 6 classroom dialogues into cognitive behavior categories that correspond either to recall skills or problem solving skills.

Results of the analysis showed that cognitive behavior mean scores improved significantly as a result of the field trip.

(viii) HOWIE, T. R. (1972)

Howie also compared the effectiveness of outdoor, indoor, and combined outdoor/indoor settings in two sub-divisions of environmental education: ecology and conservation. Conceptualization and application were the two areas of focus in evaluating cognitive learning of 438 fifth grade elementary students in Prince George's County, Maryland, Washington, D.C..

Teachers, with their students, from the entire county school system were invited to apply in order to participate in this study. The study consisted of four randomly-selected classroom groups: one control treatment and three experimental treatments. The control group was not exposed to any of the environmental education activities. The experimental treatments consisted of one outdoor group which participated in a two-day guided discovery program at the Ferguson Environmental Study Center, an indoor group which attended a minimum of ten one-hour or less sessions totally in a classroom setting and where an advance organizer technique was used, and an outdoor/indoor group which received instructions both in the classroom setting and at the Environmental Study Center.

The treatment groups' level of homogeneity was verified by means of a pretest, the Iowa Basic Skills Test Vocabulary and Reading subtest (published by Houghton Mifflin, Form A, 1971). The posttest entitled Environmental Resource Concepts and Applications Survey, was specifically designed for this study. It consisted of 30 questions; 15 were drawn from basic environmental concepts, and the remainder were concerned with the application of experiences of each of those areas. The post-test was administered the day following completion of treatments.

Statistical analysis consisted of an analysis of variance of the pre-tests and a one-way analysis of covariance for post-tests. Results indicate no significant difference between the three experimental groups. In the application's aspect of the cognitive domain as far as conceptualization is concerned however, the combined indoor/outdoor group scored higher than the other treatments. Howie concluded that the most superior method for learning both cognitive and applications of environmental concepts was the combination of both indoor and outdoor practices, and also suggested that programs of advanced organization are important prior to an efficient outdoor education activity.

(ix) BUERSTATTE, F. W. (1968)

Buerstatte conducted a study in which he compared the results obtained from the use of a field discovery approach and of a field lecture approach for fostering students' ability to observe and explain ecological relationships.

The former teaching technique fosters students' independent work while the latter leads the students into discovery.

The study was performed during the school year 1967-1968 at Hayward High School, Berkeley, California. The field study area was near the city of Hayward Park in California. One hundred and twenty biology students were randomly sampled from this high school. No details were given regarding age, grade level or sex. All were considered average students scholastically.

Students were placed into four heterogeneous classes. Classes from periods 2 and 7 formed the field discovery approach group (group A), and consisted of 32 males and 25 females. Classes from periods 1 and 4 formed the field-lecture approach group (group B), and consisted of 36 males and 19 females. All four classes received the same treatment of course content and laboratory exercises, the same text, BSCS green version, and the same library references were used by all student groups which participated in this study. In group A, students were required to submit progress reports on a field problem of their own choosing, while the students in group B were tested on knowledge gained from field lectures; the subject matter of the field lectures paralleled that of the field problems.

Both groups were tested near the end of the school year on their knowledge and understanding of this new area. Two tests were administered. One was a cognitive test that consisted of listing all of the ecological relationships found in an area in the Alameda County. The students had also to explain them if possible. The second test used was the California Psychological Inventory Test. The attitudes evaluated were dominance, capacity for status, sociability, self-acceptance, sense of well-being, responsibility, socialization and good impression. Correlations between attitude and field exams were computed to see if a particular personality is better suited to a given approach.

The results of the analysis revealed no significant differences between the students who had been subjected to the two field activities in their observations of ecological relationships. The field discovery approach, however, was found to be significantly better for promoting the students' ability to explain ecological relationships.

(x) BENNETT, L. M. (1965)

The purpose of this study was to compare the value of outdoor and indoor instructional methods in attaining specific educational objectives in the teaching of ecology. The educational objectives concerned comprehension and factual knowledge of ecological principles and attitude changes toward science and scientists. This study was performed in 1963 at Jinks Junior High School in Panama City, State of Florida. The subjects were 105 seventh grade students (boys and girls of ages between 12 and 13 years). The students were of the middle class. Subjects came from 5 homeroom classes selected because their teacher volunteered. No attempt was made to select the students by ability or IQ scores and teachers were not rated according to their teaching ability or background in science. The sample consisted of five treatments; two control groups (n= 45) which were taught ecology in the classroom and three experimental groups (n= 60) which undertook a field study covering the same ecology concepts as did the indoor groups. Students in the five treatments came from five classes which volunteered for the study. Classes were randomly assigned to treatments. Each of the five treatment groups was subdivided into two groups on the basis of intelligence scores. The instruction covered 10 school days. Content and teaching time were similar for each group. No description of the experimental-field method was given by the researcher.

The evaluation instrument used to measure cognitive achievement was developed by the investigator. It was comprised of a Comprehension Test and a Factual Information Test. Both tests were submitted to a panel of jurors from the Education Faculty of Florida State University for acceptance and were pre-evaluated under a pilot study. A Science Attitude Test developed by the same university was used in this study. Each of the three tests was given as a pre-test and a post-test for the groups which studied under each method.

Results showed no significant differences between the control and the experimental groups on factual information and attitudes. All groups demonstrated significant gains during the period of the study. Control groups scored significantly higher than experimental groups on comprehension.

4. Environmental studies

(i) PECK, R. A. (1974)

Peck studied the comparative value of outdoor, indoor and combined indoor/outdoor experiences on the topic of environmental education (conservation, pollution, politics and policy-making for a quality environment). Concept learning and attitudes toward the environment were the two areas of investigation. Data generated came from the Burke County Public School System, North Carolina. Four high schools were represented by 10th grade biology students participating in this study: Drexel High School, Freedom

High School, Hilderban High School and Valdese High School. Participants were identified through their biology teachers who committed at least one of their classes to participate in this program. The study, done during the 1973-1974 school year, consisted of four groups, one control group and three experimental groups. The experimental groups were comprised of: an outdoor group (n= 37) which was taught for five consecutive school days entirely out-of-doors, an indoor group (n= 55) which received instruction for fifty minutes on each of ten successive school days totally inside the classroom, and a combination group (n= 31) which was taught for fifty minutes on each of five consecutive school days in the classroom, and, in addition, participated in a three day outdoor experience similar to that of the outdoor group.

The control group (n= 84) was divided into 3 subgroups, each corresponding to the three experimental groups. All control subgroups attended their regularly scheduled classes between pretesting and post-testing. The time between pretesting and post-testing respected their corresponding counterpart in the experimental group i.e. 5, 8 and 10 days respectively for each control subgroup.

The instrument used for measuring the learning of environmental concepts was the "Environmental Achievement Test (EAT), developed by the Environment Ecological Education Staff and the Learning Institute of North

Carolina. This evaluation device consisted of 27 multiple-choice questions on environmental facts and concepts. Results suggest that the outdoor treatment group did significantly better than the control group and the other two experimental groups in teaching environmental concepts.

The instrument used for evaluating attitudes toward the environment was the Environmental Attitude Inventory Grade B (Fleetwood, George Robert. (1972). "Development of the Environmental Science Test and the Environmental Science Test and the Environmental Attitude Inventory". Doctoral dissertation, University of North Carolina, Chapel Hill). This instrument is self-report inventories designed to measure the extent to which an individual has positive or negative feelings toward the environment and environmental protection.

The results showed that the three experimental groups' post-test scores were significantly better (0.01 level) than those of the control group. No attempt was made, however, to match control group and experimental group attitudes before the experiment commenced.

3. Analysis of the findings

(1) The quality of research work

The difficulty of assessing the value of outdoor experiences through a revision of the scientific literature must first be addressed. The author has identified a few sources that limitate the efficiency of research work on this topic:

i) Investigators often failed to report which area of the cognitive and/or affective domain they were seeking to measure. This is particularly true of the work by Johnson (1977) who spoke in very general terms of Secondary I students' cognitive achievement.

ii) When investigators did define which dimension of the learning domains they were measuring, they often presented overall results instead of giving an individual report of findings for each of the cognitive or affective categories. As Backman and Crompton (1984) pointed out, studies should all refer to the same basic taxonomy of educational objectives. Bloom's six-level hierarchy of the cognitive domain (knowledge; comprehension; application; analysis; synthesis; and evaluation) and Krathwohl et al's (1964) of the affective domain could form a standardized basis for all researchers. Studies by Slater (1972) and by

Hosley (1974) must be commended in this regard; all of their behavioral cognitive objectives are linked to specific learning outcomes as categorized by Bloom's taxonomy.

iii) Experimental designs often presented inadequate control procedures. The control group took various forms. For some researchers, it consisted of subjects who had not participated in the outdoor field experience or in the indoor activities. This was the case in studies of Peck (1974), Hosley (1974) and Howie (1972). For others, a control group was synonymous with the indoor group. Chrouser (1970) and Kaplan (1974) used such terminology. In this case, pre-test and post-test designs were often incorporated in order to compare net gains of both methods of instruction. For still others (eg. Slater, 1972; Lisowski, 1987), there was no control group. The approach consisted of comparing test results before and after an outdoor experience without using any other means of reference.

iv) Experimental designs often presented inadequate randomization. Randomization, as Campbell and Stanley (1969) emphasized, is one of the most critical elements in developing a strong design. It consists of randomly assigning treatments to randomly selected test units. Particularly good examples of strong designs reviewed in this chapter are those by Wise (1970) and McNamara (1971).

v) Some samples used were very small (see the study of Slate (1972)).

vi) Measuring instruments were not all prepared with the same care: content validity and reliability not being tested or reported. The Student Ecology Assessment instrument developed by Lisowski (1987) was particularly well prepared. Revised three times, the test was refined with the aid of pilot studies.

vii) There was a sparsity of relevant and pertinent material related strictly to outdoor ecology education. Reseachers tended to combine ecology with other academic subjects. Ten research papers were found mostly on the topic of outdoor ecology experiences. Of this number, only one study (a study by Bennett, 1965) dealt with outdoor ecology for Secondary I students.

viii) A large diversity of subjects, grade levels, time allotments, and modes of instruction were used. This made comparisons between scientific papers difficult. A common basis of investigative approach was lacking.

(2) Results of the findings

In assessing the practical value of outdoor ecology education, three legitimate questions can be asked:

i) Did the outdoor experiences used by the various investigators contribute to the positive development of the child?

Despite all the limitations and the diversity of the experimental designs reviewed in this monograph, the overall contribution of the outdoor experiences was positive. As shown in Table 3 (pp. 86-89 inclusive), almost all research studies have reported some positive effects that were attributed to the outdoor treatment the students had experienced.

TABLE 3.

Summary of research on field ecology-related experiences

| Investigator & type of treatment. | Grade Level | Outcomes measured | Effects found* |
|---|---|---|---|
| Bennett, (1965) -two indoor groups -three outdoor groups | 7th | Factual information | No difference between treatments; |
| | | Comprehension | + Treatments over control |
| | | Science attitudes | No difference between treatments. |
| Buerstatte (1968) - field discovery - field lecture | High Sc. | Observing relationships | No significant difference between discovery field approach and lecture field trip |
| | | Explaining relationships | +For discovery group |
| Ch[illegible]user (1975) - one indoor laboratory - one outdoor/indoor laboratory | Elem Sc. | Understanding social aspects of science, biological principles & science as a process. | + For treatments over control |
| | | The ability to think critically. | No signif. difference |
| Holly (1982) - one outdoor 'hands-on' experience - one indoor treatment | 6th | Perception of classroom climate and mean achievement scores | + For treatments over control |
| Hosley (1974) - one indoor AV technique - one outdoor group - one indoor/outdoor group - one control group | 5th | Bloom's Cognitive Domain categories | + For slides and combination; No signif. diff. between the two |

TABLE 3 (cont'd)

Summary of research on field ecology-related experiences

| Investigator & type of treatment. | Grade Level | Outcomes measured | | Effects found* |
|---|---|---|---|---|
| Howie (1972)<br>- one control group<br>- one indoor advance organizer group<br>- one indoor/outdoor advance organizer group<br>- one outdoor discovery group | 5th | Application<br><br>Conceptualization | | No sign diff. between 3 exp. groups<br>Combined indoor-outdoor group scored higher than other treatments |
| Jonnson (1977)<br>- indoor group<br>- outdoor group<br>- two indoor/outdoor groups | Sec. I | Cognitive | | No significant difference between indoor and outdoor treatments |
| Kaplan (1974)<br>- outdoor group<br>- indoor group | 5-6th | Ability to recognize and identify living org. and relationships between them | + | For treatments over control |
| Lisowski (1987)<br>- three outdoor groups<br>pre- and post-tests | High Sc. | Understanding of con-cepts and retention | + | Signif. diff. between pre- and post-tests;(no control) |
| McNamara (1971)<br>- indoor lab.<br>- outdoor lab. | 8-9th | Overall achievement<br><br>Achievement on concepts<br>Critical thinking | <br><br>+<br>+ | Environment in which the lab exp. were held had no sig. effect<br>For outdoor<br>Outdoor group sign. higher |

TABLE 3 (cont'd)

Summary of research on field ecology related experiences

| Investigator & type of treatment. | Grade Level | Outcomes measured | Effects found* |
|---|---|---|---|
| Ujoke (1981)<br>- two indoor groups<br>- two outdoor groups<br>pre- and post-tests | High Sc. | Cognitive achievemen<br><br>Attitudes toward env. | + For exp. group over control<br>No sign. diff. but combination outdoor-indoor noticebly higher |
| Peck (1974)<br>- control group<br>- outdoor group (five days)<br>- indoor group (150 minutes)<br>- indoor/outdoor group | 10th | Factual and conceptual knowledge | + For outdoor group over indoor and outdoor-indoor groups |
| Slater (1972)<br>- outdoor group<br>pre-& posttests | 6th | Cognitive learning (Bloom's tax.) | + Post-field trip mean score sign. higher than pre-field trip score |
| Wise (1970)<br>- indoor group<br>- outdoor group<br>- indoor/outdoor group<br>pre-& posttests | 5th | Knowledge/recall and comprehension; | + For outdoor direct exposure treatment over indoor and indoor-outdoor treatments |
| Zwick (1977)<br>- outdoor group ('hands-on' experience)<br>- indoor group | 5th | Attitude towards the environment | + For experimental outdoor group |

*Legend: +: significant positive difference ...

This general conclusion was reached based on the statistical comparisons made of the pre-test and the post-test results using the evaluative instruments, or from comparing the achievement of the experiemental groups with that of the control groups of students who had received no instruction. This finding was supported by all reviewers (see appendix A, p. 121) who reported studies on indoor-outdoor education.

ii) How does outdoor education compare with the indoor experience?

This probably is a more crucial question since the answer could clarify whether or not the integration of outdoor activities into the Quebec ecology curriculum is worth while. If the indoor experience yields similar, or even better, learning outcomes, it becomes futile even to consider adding outdoor activities to the existing ecology program. The majority of the research comparing indoor and outdoor experiences in the area of ecology does report a more significant gain in cognitive learning in student groups following the outdoor field treatments and tends to indicate that the outdoor instruction is useful for promoting and achieving cognitive gain in ecology students when effectively managed. However, because of the diversity of the experimental studies and due to the other problems discussed earlier, this general conclusion remains tentative. These findings are supported by conclusions of reviewers such as

Crompton & Sellar (1981), Backman & Crompton (1984) and Henderson (1986).

iii) For promoting which specific cognitive and affective learning outcomes were the outdoor experiences found to be particularly useful?

This question will be answered in three sections and those references in the previous chapter (pp. 22-41) that deal with advocacy for outdoor education will be identified. The three sections are:

i.) The cognitive domain: knowledge and comprehension

ii.) The cognitive domain: application, analysis and synthesis

iii.) The affective domain

i.) The cognitive domain: knowledge and comprehension

Researchers have evaluated the acquisition of ecological knowledge and comprehension. Table 4 (pp. 91-93 inclusive) indicates the type of learning outcomes that were measured and the results that were found. All research studies which did not compare outdoor activities with an indoor treatment are not included in this Table.

TABLE 4

Description of lower degree learning outcomes measured on outdoor science experiences and effects found

| COGNITIVE CATEGORIES | ASPECTS MEASURED | EFFECTS FOUND* |
|---|---|---|
| Knowledge | Overall achievement | + Oloke (1981)<br>++ Wise (1970) |
| | Factual information | O Bennett (1965)<br>++ Peck (1974)<br>++ Kaplan (1974) |
| | Conceptualization | O Johnson (1977)<br>+ Howie (1974)<br>++ McNamara (1971)<br>++ Peck (1974) |
| Comprehension | overall achievement | ++ Wise (1970)<br>- Hosley (1974) |
| | understanding relationships | O Bennett (1965) |
| | understanding social aspects of science and science as a process | ++ Chrouser (1975) |

*LEGEND: O Significant gains recorded but no difference recorded between indoor and outdoor treatments
- The outdoor group scored significantly lower than the indoor group
+ The combined indoor/outdoor group scored significantly higher than the indoor group. (and outdoor group if present in this study)
++ The outdoor group scored significantly higher than the indoor group (and the combined indoor/outdoor group if present in this study)

This table indicates that there is a majority of findings supporting the effectiveness of the field instructional approach in the area of knowledge and comprehension (although results in the latter case are not as strongly in favor of outdoor experiences). This tends to agree with Lisowsky's conclusions on the value of outdoor ecology:

> "1. Abstract concepts related to ecology can be taught and learned effectively through an experiential field instruction program.
>
> 2. Improvement in students' understanding of specific concepts occurred after an involvement in a field-based learning program."
>
> (Lisowski, 1987, p. 213)

For Koran and Baker (1979), who evaluated the effectiveness of field trip experiences of eight scientific studies, this value does not exceed classroom learning on measures of knowledge. My review of the findings in the area of ecology suggest, on the contrary, that in the acquisition of basic ecological knowledge, one of the objectives of the MEQ ecology curriculum could certainly be facilitated through the development of outdoor experiences.

It should not be concluded, however, that out-of-classroom learning experiences are sufficient in themselves to produce cognitive gains. Many of the studies reported in this paper have used subjects who had had a basic science background acquired through the classroom environment. Also, many experimental outdoor studies reviewed in this Chapter were combined with an indoor instruction session.

ii.) The cognitive domain: application, analysis and synthesis

According to Bloom's taxonomy, application, analysis and synthesis are three cognitive categories of higher degree of difficulty. Many investigators have measured these learning outcomes but very few have reported results specifically on these categories so that the effectiveness of the outdoor experiences in meeting these higher cognitive outcomes can only be assessed tentatively. Table 5 indicates the types of higher learning outcomes that were measured and the effects found. As shown, research showing positive effects on the higher cognitive objectives appears rather inconclusive. Studies in these areas are too scarce to draw any valuable conclusions. The MEQ ecology curriculum puts an emphasis on the scientific method which, as process, could help promote the development of all the cognitive categories described by Bloom in his taxonomy of educational objectives. Although the 12 and 13 year old pupil for whom the ecology course is designed does not possess the skills necessary to implement all the steps of the scientific process, it would be interesting to find out what are the skills and attitudes that the outdoor experiences can best develop which are required for the scientific method.

TABLE 5

Description of higher degree learning outcomes measured for on outdoor science experiences and effects found

| COGNITIVE CATEGORIES | ASPECTS MEASURED | RESULTS FOUND |
|---|---|---|
| Application | Not specified | o Howie (1974) |
| Analysis | Critical thinking | o Chrouser (1975)<br>++ McNamara (1971) |
| Overall cognitive outcome including application, analysis and synthesis | ------- | - Hosley (1974)<br>o McNamara (1971)<br>++ Oloke (1981) |

*LEGEND: O Significant gains recorded but no difference recorded between indoor and outdoor treatments
- The outdoor group scored significantly lower than the indoor group
+ The combined indoor/outdoor group scored significantly higher than the indoor group (and outdoor group if present in this study)
++ The outdoor group scored significantly higher than the indoor group (and the combined indoor/outdoor group if present in this study)

iii.) The affective domain

In the literature there are a number of studies about the effects of outdoor education on the affective development of the child. However, most of this research deals with recreational activities. Most studies reported by Crompton & Sellar (1981) and Henderson (1986) indicated that field activities were effective in developing the child 's attitude in the affective domain (self-concept, socialization and attitude toward the out-of-door as a learning environment). In the area of outdoor ecology, the author found very few studies that deal with the affective domain. In an era where environmental awareness is becoming more and more urgent, it is surprising to see that little has been published on the value of outdoor environmental education in developing proper attitudes toward the environment.

Four studies reviewed in this chapter assessed the positive effects of outdoor ecology activities in the affective domain. The first study dealt with students'feelings toward their classroom climate. Holly (1982) has found that classroom climate was perceived to be significantly better following a six-week outdoor environmental education unit of study. We recall that most of the attitudes promoted in the MEQ's ecology course focus on the individual. A better perception by the students of the classroom environment could have been facilitated by various factors, such as: better student/student and students/teacher relationships in a more relaxed outdoor atmosphere, courtesy, patience and cooperativeness developed through exciting outdoor adventures, etc. The three other studies dealt with environmental awareness, a major theme in the MEQ ecology curriculum. Oloke (1981) found that the indoor/outdoor laboratory method of teaching was at least as effective in promoting a positive ecological attitude as a more traditional method of teaching. Zwick (1977) who produced the evaluative instrument used by Oloke and who focused his research entirely on affective issues found that students' attitudes toward their environment were changed in a positive direction through participation in a field ecology program compared to an indoor experience which did not produce changes as significant. Chrouser (1975) who did not try to assess affective changes studied students' understanding of their role in the environment. His findings indicated that students had a significantly better understanding of their social role in the environment after a field activity exposure. This cognitive gain can be assumed to eventually bring about attitude changes toward the environment, and, in this respect, support Zwick's conclusion.

The above findings bring qualified support for the integration of field activities into the ecology course in the area of students' perception of other people and of the environment (refer to chapter III p. 34 on the two major goals of the MEQ Ecology Curriculum).

Although most empirical and theoretical studies (see chapter III, p. 22) speak in favor of the affective value of outdoor education and support the very few studies reviewed in this paper, there is still a need to concentrate and accentuate the research on the exact topic of this monograph which concerns the teaching of ecology at the Secondary I level.

4. <u>Summary</u>

As a result of a study of the research available in the area of outdoor ecology education, it would appear that learning can take place in the out-of-doors. Most of the studies reviewed in this chapter compared the field trip technique to the classroom technique. Many of these studies also showed that cognitive achievement in the area of knowledge and comprehension was greater in the out-of-doors than in the traditional classroom environment. Results in the higher cognitive levels (application, analysis, synthesis and evaluation) were inconclusive. The very few studies that were reviewed which tried to assess the affective value of ecology field trips showed the positive effect of outdoor experiences in the areas of environmental awareness and classroom climate over the traditional indoor method. The author has identified a few problems in trying to assess the value of ecology outdoor education through a review of the scientific literature. Problems such as poor experimental designs, lack of standardized experimental procedures among studies, and scarcity of studies on the topic of outdoor ecology for Secondary I students were some of the major impediments in drawing general conclusions.

# CHAPTER V

## CONCLUSION,

## RECOMMENDATION AND SUMMARY

"Excitement and stimulation come from inquiring about real things. The outdoors is an ideal laboratory."

Mackillican, W., et al (1969)

## CHAPTER V

## CONCLUSION, RECOMMENDATION AND SUMMARY

The purpose of this study was to assess the cognitive and affective outcomes of outdoor ecology-related experiences in order to substantiate the usefulness of their integration into the Quebec ecology Sec. I Curriculum.

This chapter is divided into sections concerning (1) the conclusions drawn from this monograph, (2) recommendations for further study, and (3) a summary of the study.

### 1. Conclusions

The following conclusions can be drawn from this study:

(1) Results found in the research available on outdoor

ecology are conclusive to the extent that all of the studies reported in this monograph supported the idea that learning can take place in the out-of-doors. A majority of the studies suggested that cognitive achievement in the area of knowledge and comprehension and affective achievement in the area of environmental awareness could be better facilitated by the outdoor experience as opposed to an indoor approach.

(2) The value of outdoor education for the MEQ Ecology Secondary I Curriculum remains uncertain to the extent that the research available is extremely limited and usually covers various age levels. The experimental designs are also diversified and not of equal quality.

2. <u>Recommendations</u>

Before proposing the integration of an outdoor program into the Ecology Curriculum, further research will be required. The experimental designs should share the following characteristics:

(1) All studies should be strongly designed. Work by Wise (1971) could serve as a reference. Subjects and teachers are randomly selected and treatments randomly assigned.

(2) Learning objectives should be stated clearly and refer to a common taxonomic basis.

(3) Learning outcomes should be tested and results reported separately.

(4) Modes of instruction and learning content should be described in detail. Teaching methods should emphasize the scientific methodology.

(5) Evaluative instruments should, as much as possible, be common to all studies that share similar learning content and modes of instruction. The development of these evaluative instruments should be done with great care.

(6) Research studies should focus on the comparison of indoor and outdoor instruction techniques.

(7) Learning content should focus on ecological principles.

(8) Learning objectives should cover a large array of cognitive and affective outcomes.

(9) The outdoor environment should be clearly described.

The adoption of common measures to evaluate the effectiveness of outdoor ecology instruction should help reseachers to better assess the problem. Most researchers (see chapter 1, pp. 6-7) who have tried to assess the value of outdoor education came to the conclusion that results were uncertain. Through the use of recognized common evaluative methods such as strong experimental designs, common age level of subjects, common learning content, etc., studies should be better equipped to evaluate the outdoors' potential.

It should be clarified, however, that the difficulty to assess the empirical value of environmental outdoor education does not necessarily imply that this particular approach ought to be rejected. It is not because one mode of instruction is not 100% substantiated that it is automatically invalid. The quality of the investigative methods and the expertise of the researchers seems to be the problem more than the teaching technique itself. Experiential outdoor programs already exist and their creation did not wait for the approval of the scientific milieu, and yet some of them seem to be doing very well. Such is the case of the Outdoor Biology Instructional Strategies project, also called OBIS, which was created in 1972 at the University of Berkeley in California (see McCormack, 1974 and Falk, Malone & Linn, 1975). The project's goal was to develop activities which encourage 10-15 year old students to investigate ecological principles in an outdoor setting in order to foster observation and understanding in ecology. In England, the Urban Spaces Scheme project (see Hale, 1985), established in 1983, was designed to assist local schools in developing ecology programs for the local environment.

Too many examples exist that favor ecology field studies for them to be ignored, or, at least, be under-exploited.

3. Summary

The purpose of this monograph was to assess the potential value of integrating outdoor activities into the Quebec Secondary I Ecology Curriculum. In order to achieve this objective, three approaches were used. Firstly, a survey of the contemporary needs of science education in the area of ecology was undertaken in order to identify where outdoor experience could be most required. It appears that at the eve of the 21st century, attention should be focused not only on the discipline, but also on the individual and on the social levels of education. Environmental awareness and scientific literacy are among the two main preoccupations of contemporary science education. Secondly, using a survey of the arguments of educators who advocate using field trips, a presentation of the theoretical value of outdoor education was made. Many outstanding educators have advocated the advantage of out-of-the-classroom settings in the areas mentioned above. And thirdly, a review of the scientific research on outdoor ecology-related activities was assembled to permit an assessment of the practical value of outdoor ecology education. Fifteen studies were reviewed; ten of them dealt directly with ecology, and the other five had portions of their learning program on ecological concepts. In light of the research reviewed, it would appear that learning can take place in the out-of-doors. Most of the studies also showed that cognitive achievement in the areas of knowledge and comprehension was greater in the out-of-doors than in the traditional classroom environment. The very few studies that were reviewed which tried to assess the affective value of ecological field trips showed a significant positive difference resulting from the outdoor experiences over the indoor classroom environmental experiences in the areas of environmental awareness and classroom climate. Considering the importance that is now placed on the environmental crisis and the need for students to become scientifically literate, it would appear that outdoor education has the potential to facilitate the MEQ ecology curriculum learning objectives. The author reiterates, however, the need for more research in the areas of cognitive and affective outdoor learning in environmental education. The difficulty of measuring efficiently some of the learning outcomes, the great diversity of the experimental designs, the scarcity of relevant and pertinent material related to junior high school ecology, and other related problems support this recommendation.

# REFERENCES

Adams, C.E. (1982). Wildlife Resources Applied to Contemporary Goals in Biology. The American Biology Teacher, 44(4), 224-228, 253.

Asbaugh, B.L. (1967). Scientific Uses of the Outdoors in Education. Science Teacher, 34, 53-55.

Backman, Sheila J., & John L. Crompton (1984). Educational Experiences Contribute to Cognitive Development. Journal of Environmental Education, 16(2), 4-13.

Bennett, L.M. (1965). A Study of the Comparison of two Instructional Methods: The Experimental-Field Method and the Traditional Method, Involving Science Content in Ecology for the Seventh Grade. Science Education, 49, 453-468.

Bennett, D.P. & D.A. Humphries (1974). Introduction to Field Biology, 2nd edn. London: Edward Arnold.

Bicack, L.J. (1982). Schoolyard Science. American Biology Teacher, 44(3), 153-156, 196.

Biggs, A. & Patrick Tap (1986). The School Surroundings- a Useful Tool in Education. BioScience, 31(10), 741-745.

Blackwood, Paul E. (1966). Outdoor education and the discovery approach to learning. Journal of Outdoor Education, 1, 6-8.

Bloom, Benjamin S. (1956). Taxonomy of Educational Objectives-Handbook I: Cognitive Domain. New York: David McKay Co. Inc.

Bokhorji-Gwawanni, Abdul Fattah R. (1985). Utilization of Field Trips in Teaching Science in the Boys' Intermediate Schools in Saudi Arabia: A Study of Educational Policy Implementation. Doctoral Dissertation, Michigan State University.

Brenman, Matthew J. (1967). Biology Out-of-Doors in the Elementary School. American Biology Teacher, 29, 207-210.

Buerstatte, F.W. (1968). Benefits of the Field Discovery Approach to High School Biology Students. Doctoral Dissertation. University of California, Berkeley.

Caldwell, Lynton K. (1970). Environment and the Shaping of Civilization. The Journal of Environmental Education, 2(2), 6-8.

Campbell, D.T. & J.C. Stanley (1969). Experimental and Quasiexperimental Designs for Research. Chicago, IL: Rand McNally College Publishing Company.

Carlson, R.E. (1973). Enriching the School curriculum by using the immediate environment. In Hammerman, D.R. & W.N. Hammerman, (Eds), Outdoor education, (2nd ed). (pp. 122-126) MN: Burgess.

Charles, Cheryl (1986). A Necessary Synthesis: Creating an Ecological, whole Learner Approach to Teaching and Learning about Science, Technology, and Society. Paper presented at the Stawide Science Staff Development Conference. Colombus, Ohio.

Chrouser, W.H. (1975). Outdoor vs indoor laboratory techniques in teaching biology to prospective elementary teachers. Journal of Research in Science Teaching, 12(1), 41-48.

________________ (1970). A Comparison of the Use of Outdoor vs Indoor Laboratory Techniques in Teaching Biology to Prospective Elementary Teachers.

Doctoral dissertation, University of Northern Colorado, Greely, Colorado.

Crompton, J.L. & Christine Sellar (1981). Do outdoor Education Experiences Contribute to Positive Development in the Affective Domain? The Journal of Environmental Education, 12(4), 21-30.

Cultice, Wendell W. (1967). Field Trips, and How to Make Sure Your School Gets the Most Out of Them. Englewood Cliffs, N.J.:Prentice-Hall Inc.

Dewey, John (1938). Experience and Education. NewYork: Collier.

_________________ (1916). Democracy and Education. New York: Macmillan.

Dirienzo-Shalecki, Denise (1981). Summer Adventure in Yosemite National Park. The American Biology Teacher, 43(5), 267-269.

Disenger, John (1987). Cognitive Learning in the Environment: Elementary Students. ERIC/SMEAC Environmental Education Digest no.2 ERIC Clearinghouse for Science, Mathematics... Columbus, Ohio.

Evans, Stewart M. (1988). Man and the Environment: the Need for a more Realistic Approach to Teaching Ecology. Journal of Biological Education, 22(2), 136-138.

Falk, J., L. Malone & M. C. Linn (1975). Outdoor Biology Instructional Strategies: Development and Evaluation. American Biology Teacher, 37(2), 162-164, 173.

Forster, Felix A. (1961). An Evaluation of the Field Trip in the Formation of Social Concepts and Generalizations. Dissertation Abstracts, 22, 181.

Gaudin, Felix A. (1984). Are Biology and Chemistry Out of Order? Science Teacher, 51, 29-31.

Glasser, William (1969). Schools without Failure. New York: Harper & Row.

Gouvernement du Quebec. Ministère de l'Education (1987). Curriculum Guide Ecology Secondary School. Quebec. Doc. no. 16-3143-02A.

__________ (1984). Elementary School Curriculum, Natural Science. Quebec. Document no. 16-2102A.

__________ (1983). Ecology Secondary School Curriculum. Quebec. Doc. no. 16-3143-01A.

Hale, Monica (1986). Approaches to Ecology Teaching: The Educational Potential of the Local Environment. Journal of Biological Education, 20(3), 259-262.

__________________ (1985). Expanding the Horizons of Urban Ecology. Journal of Biological Education, 19(4), 259-262.

Hall, C.H. & E.L. Wright (1980). Factors Influencing the Use of Suburban School Grounds for Class-time Secondary Science Instructional Activities. Paper presented at the annual meeting of the National Association for Research in Science Teaching. 53rd, Boston, April 11-13.

Hammerman, Donald R. & William M. Hammerman (1973). Outdoor Education. (2nd ed) Minnesota: Burgess Publishing Company

__________________ (1964). Teaching in the Outdoors. Minnesota: Burgess Publishing Company.

Harms, N.C. (1977). Project Synthesis: An Interpretive Consolidation of Research Identifying Needs in Natural Science Education. University of Colorado, Boulder.

Harvey, Helen W. (1951). An Experimental Study of the Effect of Field Trips upon the Development of Science Class. Science Education, 35, 242-248.

Heiss, E.D., E.S. Obourn & C.W. Hoffman. (1950). Modern Science Teaching. New York: The Macmillan Comp.

Henderson, Fred L. (1986). An Annoted Bibliography of Abstracts, Doctoral Dissertations and Journals Dealing with the Utilization of the Outdoors to Enrich the Curriculum and to Promote More Effective Learning in the Elementary and Secondary Students. Exit project. Indiana University of South Bend.

Holly, Joyce C. Thomas (1982). A Comparative Study of Outdoor and Indoor Instruction in Ecology Studies on Student Perceptions of Classroom Climate and Achievement at the Sixth Grade Level of a Large Metropolitan School District. Doctoral Dissertation, University of Southern Mississippi.

Hosley, E. (1974). A Comparison of two Methods of Instruction in Environmental Education. Doctoral Dissertation. University of Maryland.

Howie, T.R. (1972). The effectiveness of Outdoor Experience Versus Classroom Experience in Learning the

Cognitive Dimensions of Environmental Education. Doctoral Dissertation, the George Washington University.

Hug, John W. & Phyllis J. Wilson (1965). Curriculum Enrichment Outdoors. New York: Harper & Row.

Johnson, G. (1977). A Comparison of Eight Grade Pupils' Achievement in Selecting Portions of Biology Using the Traditional Indoor Environment and the Experimental Outdoor Environment Taught from an External Morphological Approach. Doctoral Dissertation, Pennsylvania State University.

Kahle, J.B. (1976). Teaching Science in the Secondary School. New York: D. Van Nostrand Comp.

Kaplan, J.B. (1974). Cognitive Learning in the Out-of-doors. Masters thesis. The Pennsylvania State University.

Kennedy, M.H. & F.M. Hickman (1981). A New Decade for Biology Education. Bioscience, 31(10), 741-745.

Keown, Duane (1986). Teaching Science in U.S. Secondary Schools: A Survey. Journal of Environmental Education, 18(1), 23-29.

____________ (1984). Let's Justify the Field Trip-How-to-do-it. The American Biology Teacher, 46(1), 43-48.

Kilpatrick, W.H. (1942). The Role of Camping in Education Today. Camping Magazine, 14, 14-17.

_________________ (1963). Philosophy of Education. New York: Macmillan.

Knapp, C.E. (1989). Humanizing Outdoor Education. Exploring the Affective Domain. Journal of Physical Education, Recreation and Dance, 60, 40-43.

Koran, J.J. Jr., & S.D. Baker (1979). Evaluating the Effectiveness of Field Trip Experiences. In M.B. Rowe: what research says to the science teacher, vol. 2 (pp. 50-67). Washington, D.C: National Science Teachers Association.

Krathwohl, David R. et al. (1964). Taxonomy of Educational Objectives-Handbook II. Affective Domain. New York: David McKay Inc.

Krepel, Wayne J. & Charles R. Duvall (1981). Field Trips: a Guide for Planning and Conducting Experiences. A National Education Ass. Publication.

Lambert, J.M. & G.T. Goodman (1967). Basic Problems in the Teaching of Ecology. In The Teaching of Ecology. British Ecological Society Symposium Number 7, ed. Lambert, J.M. (pp. 3-10). Oxford: Blackwell Scientific.

Lebreton, P.H. & P. Samuel (1976). L'homme et son environnement. Les Encyclopédies du Savoir Moderne. Paris.

Lisowski, Marylin (1987). The Effect of Field-Based Learning Experiences on Students' Understanding of Selective Ecological Concepts. Doctoral dissertation, Ohio State University.

Lisowski, Marylin & John F. Disinger (1987). Cognitive Learning in the Environment. Secondary Students. ERIC/SMEAC Environmental Education Digest no. 1.

Mackillican, W., Audrey E. Wilson & Yvan Wooly (1969). The Outdoors: Studies for Open Spaces. Toronto: McGraw-Hill Book Comp.

Mantle, G. & S. Heath (1986). The Use of Urban Open Spaces for Environmental Education. Journal of Biological Education, 20(4), 279-286.

McCormack, Allen J. (1984). Recommendations of the NSB Commission that No One Noticed. The American Biology Teacher, 12(2), 9-12.

__________________ (1974). OBIS: Outdoor Biology Instructional Activities. Science and Children, 12(2), 9-12.

McNamara, E.S. (1971). A Comparison of the Learning Behaviors of Eighth and Ninth Grade ESCP Earth Science Students; One Half Experiencing Laboratory Investigations in the Indoor Environment, the Other Half Experiencing Laboratory Investigation in the Outdoor Environment. Doctoral Dissertation, Pennsylvania State University.

Meyer, G. Rex, & A.N. Rao (1984). Teaching Science Out-of-school with Special Reference to Biology. Asian Network for Biological Sciences. ERIC document 263 004.

Oloke, Lot Oloruntoba (1981). A Comparative Study of an Indoor-Outdoor Laboratory Method of Teaching Ecology in a Secondary School in Nigeria. Masters thesis, University of Northern Colorado.

Orpwood, Graham W. F. & Jean-Pascal Souque (1985). Toward the Renewal of Canadian Science Education. II Findings and Recommandations. Science Education, 69(5), 625-636.

Peck, R.A. (1974). A Study Comparing Outdoor, Indoor and Outdoor-Indoor Settings for Teaching Specific Environmental Education Objectives. Doctoral Dissertation, University of North Carolina at Chapel Hill.

Penik, John E. & Robert E. Yager (1986a). One Way to Fix School Science. _The Science Teacher_, _53_(1), 147.

__________________ (1986b). Science Education: New Concerns and Issues. _Science Education_, _70_(4), 427-431.

Piaget, J. (1964). Development and Learning. _Journal of Research in Science Teaching_, _2_(3), 176-186.

Postlewait, S.N. (1980). Improvement of Science Teaching. _Bioscience_, _30_(9), 601-604.

Proctor, M.C.F. (1967). The Descriptive Approach to Vegetation Studies. In _The Teaching of Ecology_. British Ecological Society Symposium. Number 7, Ed. Lambert, J.M. (pp. 113-124). Oxford: Blackwell Scientific.

Reichert, Deborah E. (1987). Ecological Awareness in the Biology Classroom. _The American Biology Teacher_, _49_(5), 298-299.

Riban, R.M. & J.B. Koval (1971). An Investigation of the Field Studies in Science on the Learning of the Methodology of Science. _Science Education_, _55_(3), 291-294.

Russell, Bertrand (1921). _The Analysis of Mind_. London: Allen and Unwin.

Sankey, J. (1958). A Guide to Field Biology. London: Longman.

Science Council of Canada (1984). Science for Every Student: Educating Canadians for Tomorrow's World. Ottawa: Science Council of Canada Report.

Sharp, L.B. (1952). What is Outdoor Education? The School Executive, 71, 19-22.

Sharpe, G.W. (1976). Marine Interpretation, In Sharpe, G.W., (Ed.). Interpreting the Environment, (pp. 443-471) New York: John Wiley.

Sheail, J. (1987). Seventy-five Years in Ecology: The British Ecological Society. Oxford: Blackwell Scientific.

Slater, D.P. (1972). The Effect of an Outdoor Experience on Sixth Grade Students' Cognitive Understanding of Ecological Concepts. Doctoral Dissertation, University of New Mexico.

Sorrentino, Anthony V. & P.E. Bell (1970). A Comparison of Attributed Values with Empirically Determined Values of Secondary School Science Field Trips. Science Education, 54, 233-236.

Stotler, D.W. (1967). Science in the Outdoor Laboratory. The Science Teacher, 34, 40-42.

Thier, Herbert D. (1981). From SCIS to PELE: Approaches to Affective Dissemination Implementation and Adaptation of Instructional Programs. Science Education, 65(1), 105-113.

Wagar, J. Alan (1970). The Challenge of Environmental Education. Today's Education. pp 15-18.

Wheater, C.P. (1989). A comparison of two formats for terrestrial behavioural ecology field courses. Journal of Biological Education, 23(3), 223-229.

Wise, R.C. (1970). Outdoor Versus Indoor Learning in Elementary School Science. Doctoral Dissertation, Pennsylvania State University.

World Conservation Strategy (1980). International Union for Conservation of Nature and Natural Resources (IUCN), with the United Nations Environment Programme (UNEO), and the World Wildlife Fund.

Wratten, S.D. & G.L.A. Fry (1980). Field and Laboratory Exercises in Ecology. London: Edward Arnold.

Yager, Robert E. (1986). What's Wrong with School Science? Science Teacher, 53(1), 145-147.

Zwick, Thomas T. (1977). An Investigation into the Affective Behavior of Students in the Environmental Education Program in School District 2, Billings, Montana. Doctoral Dissertation, University of Northern Colorado, Greely, Colorado.

# APPENDICES

# APPENDIX A

## REFERENCES: REVIEW PAPERS ON THE VALUE OF OUTDOOR EDUCATION

Backman, Sheila J., & John L. Crompton (1984). Educational Experiences Contribute to Cognitive Development. Journal of Environmental Education, 16(2), 4-13.

Crompton, J.L. & Christine Sellar (1981). Do outdoor Education Experiences Contribute to Positive Development in the Affective Domain? The Journal of Environmental Education, 12(4), 21-30.

Disinger, John (1987). Cognitive Learning in the Environment: Elementary Students. ERIC/SMEAC Environmental Education Digest no.2 ERIC Clearinghouse for Science, Mathematics... Columbus, Ohio.

Henderson, Fred L. (1986). An Annoted Bibliography of Abstracts, Doctoral Dissertations and Journals

Dealing with the Utilization of the Outdoors to Enrich the Curriculum and to Promote More Effective Learning in the Elementary and Secondary Students. Exit project. Indiana University of South Bend.

Koran, J.J. Jr., & S.D. Baker (1979). Evaluating the Effectiveness of Field Trip Experiences. In M.B. Rowe: What Research Says to the Science Teacher, vol. 2 Washington, D.C. National Science Teachers Association, pp. 50-67.

Lisowski, Marylin & John F. Disinger (1987). Cognitive Learning in the Environment. Secondary Students. ERIC/SMEAC Environmental Education Digest no. 1.

Sorrentino, Anthony V. & P.E. Bell (1970). A Comparison of Attributed Values with Empirically Determined Values of Secondary School Science Field Trips. Science Education, 54, 233-236.

# APPENDIX B

## COPY OF THE ECOLOGY CURRICULUM DOCUMENT, SECONDARY I, MINISTRY OF EDUCATION, QUEBEC (1983).

# Table of contents

# 1. Introduction

There are many pressures exerted today on the school and its curriculum. These pressures often tend to have a restrictive effect on the educational process and in order to counter this, society must make a concerted effort to define its educational goals. The following questions illustrate the nature of current concerns:

— What kind of society do we wish to have?
  What kind of persons do we wish to be?
  How can we integrate man's varied activities with his aspirations to enable him to be an active participant in his society?

— What kind of skills and knowledge should be taught to pupils to give them an understanding of ecology that, as adults, will enable them to respond to the needs of our time and to seek a better quality of life for all?

— What approach should the teacher adopt in order to transmit a respect for nature, for the laws of ecology, for man, his dignity, and his future?

These are the questions that astute educators are studying, and that this ecology course attempts to address.

## 1.1 The Environmental Situation

Man's behaviour towards nature is causing a progressive deterioration in the quality of the environment in which we live. Thoughtless use and exploitation of both renewable and nonrenewable resources, and the spiralling growth of the consumer society, are changing the nature and rhythm of man's life, frequently causing excesses, imbalances, and contradictions.

### Where Do We Stand?

Increasing productivity and a decrease in man's work-load are causing some important economic repercussions. The aim of the industrial society is to satisfy every desire and to meet every need. An even greater concern is the fact that producing and consuming have, without people really being aware of it, become the main aims of our society. Michel Maldague puts it very well when he says, "Most of our contemporaries are unaware (however) of the gravity of the situation until their own immediate circle of interest is concerned (family, work, entertainment, daily routine) . . ."[1]

Even though the nature of man's needs has evolved over time, everything seems to have become more complex for him. Simple things no longer give him the satisfaction they once did. While he still seeks happiness today, he is influenced by a technology that is evolving at a faster rate than his way of life. He has become conditioned to demand more and more, knowing that anything he may lack will, sooner or later, be available to him because there is no limit to what science can do. . . Nevertheless he is caught up in uncertainty, threatened by many things, not the least of which are various kinds of pollution, ecological disasters, and the energy crisis.

The consumer is well aware, even if he has difficulty facing reality, that it will not be easy to solve these problems. He seeks a satisfactory way to pursue his own personal development by trying to bring about changes in the political power structure, particular social actions, or his own working conditions.

For his part, the pupil is also confronted by a number of contradictions which he perceives in the behaviour of the adults in society. Whose example should he follow? Whom should he believe? He is confused, and his reactions, at this stage still quite mild, are to be seen in his rejection of some of the values passed down from the older generation.

The state of degradation of the biosphere and the dissatisfaction of individuals leave no doubt in the minds of any serious observers that our civilization is experiencing an environmental crisis. This crisis can be described as a ". . . profound imbalance in the relationship and interactions between man and his environment."[2]

### Can the Balance Be Restored?

Several organizations and individuals have already stressed the importance of the environmental crisis, as attested by this quotation from Michel Maldague, "The solution to the acute problems which are at the root of man's environmental crisis must be based on public awareness of the gravity of the situation and a willingness to act. Only a concerted effort on the part of everyone will enable us to find new avenues to pursue, based on humanistic objectives and consonant with the evolution of man, in order to ensure the future of human society."[3]

1. Maldague, Michel. "La nouvelle éthique universelle, finalité de l'éducation mésoligique." Conférence de la semaine nationale de la Direction générale du développement pédagogique. Université Laval, Québec, May, 1979. P. 12. (This citation is a free translation.)
2. Maldague, Michel. Op. cit., p. 4. (This citation is a free translation.)
3. Maldague, Michel. Op. cit., p. 12. (This citation is a free translation.)

### Is it Possible to Provide a Valid Education in an Environment That Is in the Process of Deteriorating?

It is possible to reorient science and technology in such a way that there would be more advantages and fewer disadvantages for the individual. Such a change could be brought about without necessarily changing the industrial system or regressing to a former way of life.

### Is a Change of Attitude Possible?

A social trend is taking place today which is encouraging those concerned with the quality of the environment to draw up broad guidelines for accomplishing the desired improvements. Prompted by a growing fear of the dangers that threaten his civilization, man is seeking to redress the situation for the twenty-first century. To this end, man is trying to create a new society in which human values and human potential are the criteria on which decisions concerning social organization and community life are based.

For the pupil, as for the adult and the community, the main problem is not in understanding the issue, but rather in finding the right attitude to, and the best way to organize, effective action.

## 1.2 Priority Needs

A new approach to the teaching of natural science is necessary if the existing situation and the desired changes are to be reconciled, and if the needs of pupils, society, and the discipline are to be met.

A survey to ascertain the main interests of 12 and 13 year old pupils was carried out so that the new Ecology course could be designed to conform as closely as possible to their expectations. Table 1 gives the results of this survey and lists the pupils' desires, concerns, and needs.

TABLE 1: **Needs and Desires of the 12 and 13 Year Old Pupil**

Knowledge:

- need to learn;
- need to understand;
- desire to find explanations.

Activities:

- need to have practical, "hands-on" experience;
- desire to handle different apparatus and instruments;
- desire to record observations.

Attitudes:

- desire to change the world;
- need to be appreciated for what he does;
- need to enjoy what he does;
- desire to overcome his fear of the unknown.

A series of consultations to evaluate needs, held with those responsible for the teaching of ecology, revealed a certain lack of understanding of the changes that have taken place in the teaching of natural science, of its social implications, of its contribution to modern scientific education, and the lack of a truly ecological orientation.

To see the problem in a broader perspective, the main statements about the future which have been made by well-known people throughout the world must be examined. These statements are, in fact, an urgent invitation to man and society to re-establish a balanced relationship with nature as quickly as possible. Each individual is urged to make every effort to learn to identify the problems, to face them, and to find solutions to them.

## 1.3 One Solution: The Teaching of Ecology

Ecology, the science of the study of the concrete interactions in the environment, should help the secondary school Cycle One pupil to meet his needs.

This is the conclusion reached by the group of teachers responsible for updating the program, in their report on the rationale for teaching ecology at the beginning of secondary school.

This opinion is based on the following factors:

1. Discovering the environment:

   The pupil should learn about the interdependence of living organisms and of living organisms and their environment.

2. Self-discovery:

   The humanistic orientation of this science, by encouraging a love of nature, should help the pupil to learn about himself, to gain self-confidence and, at the same time, to discover the importance and the real values of life and of man.

3. Developing a social ethic:

   As the pupil comes to respect the things which surround him, to discover the environment, and to feel the enthusiasm engendered by his observations, he should participate with confidence in the efforts that his society makes to ensure the survival and welfare of the community.

4. The capacity for adaptation:

A better knowledge of the laws of ecology should help the pupil to develop an open-minded approach to the learning attitudes he needs for his own personal growth. In this way, ecology should help the pupil to become an integrated member of a dynamic society."[1]

In following these guidelines the course uses the educational approach adopted by Environnement-Quebec, which emphasizes the fact that "the concept of environmental education is global and closely linked to the concept of the environment itself. It can be defined as an integrated continuing education which places emphasis on cognitive, affective, and behavioural objectives."[2]

## 1.4 Relationship Between This Course and the Elementary School Natural Science Program

The Ecology course in designed to be a continuation of the learning objectives of the elementary school Natural Science Program.[3] Some of the learning objectives (attitudes, skills, and knowledge) of the elementary and secondary courses have a similar orientation, but the level of difficulty is different. Any objectives that have not been achieved by the end of elementary school will be the subject of more intensive and detailed study in the first year of secondary school.

## 1.5 Relationship Between This Course and Other Secondary One Subjects

The Ecology course has areas in common with other Secondary One subjects, as outlined below:

- spoken and written language — investigation, précis and discussion;
- art — activities which involve techniques of illustration, diagram making, modelling, and model construction;
- mathematics — application of basic operations, graphs, and histograms;
- general geography — climatology;
- physical education — themes relating to the physical environment and the outdoors.

## 1.6 Relationship Between This Course and the Overall Goals of Education

The aim of the Ecology course is to achieve as effectively as possible the objectives formulated for secondary schools in *The Schools of Québec*:

"— to introduce the students to the many areas of knowledge and technology in order to ensure their general education;

— to instill working methods and an exact intellectual methodology, to promote the progressive development of independent thought;

— to provoke in the students a type of learning conducive to integrating the acquisition of knowledge to personal experience;

— to bring the students to discover gradually the rewards and challenges of the society to which they belong."[4]

# 2. Orientations

## 2.1 Values and Goals of Education

To ensure an orientation that conforms to the policy stated in the *Plan of Action*, this Ecology course uses the means proper to the discipline of ecology in order to achieve the overall values and goals set for the schools. "In order to attain its objectives and in so doing, transmit the accepted values, the school must carry out its task with vigour and enthusiasm."[5]

Based on the premise that teaching is primarily a relationship between individuals, this course

1. Association des professeurs d'Écologie de la Région de Québec. *Programme renouvelé de l'enseignement de l'Écologie*. Québec, February, 1977. p. 2. (This citation is a free translation.)
2. Environnement-Québec. Service des communications, Division de l'Éducation. *Du concept d'environnement à celui d'éducation à l'environnement*. Québec, October, 1979. (This citation is a free translation.)
3. Québec. Ministère de l'Education, Direction générale du développement pédagogique. *Programme d'études primaire, sciences de la nature*. Québec, June, 1979. pp. 7-8.
4. Québec. Ministère de l'Éducation. *The Schools of Québec — Policy Statement and Plan of Action*. Québec: Éditeur officiel du Québec, 1979. p. 31.
5. *The Schools of Québec — Policy Statement and Plan of Action*. Op. cit., p. 34.

focuses on the following values: respect for life, a regard for the community and the environment, a concern for the future, methodical work habits, and the importance of participation.

## 2.2 The Background of the Course

A number of philosophical, psychological, social, and educational factors were taken into consideration in developing this course.

### 2.2.1 Philosophical Background

Man is no longer in a position to think of himself as master of the planet. He is an integral part of nature, and is dependent upon nature. This concept of the relationship between man and nature denies man's right to exert total control over the environment. There was a time when man had to husband the natural resources that were available to him in order to ensure his survival. Since that time, however, man has changed his ways and his subsequent actions have brought about catastrophic consequences. Until now nature has borne the burden of these excesses, but the threat of disaster looms on the horizon. There is an increasing number of scientific studies which point out the limits of our planet's resources and the fragility of its regenerative mechanisms.

### 2.2.2 Psychological Background

"The development of thought is a creative process and therefore the community and the school should provide learning situations which will encourage the development and learning of new concepts."[1] In spite of the fact that the thought processes of the young adolescent are not always logical, there are certain patterns of thought that are characteristic of this age group. The young adolescent develops and refines his ability to make abstractions and hypotheses. As he progresses from the use of one variable for solving problems to the use of several variables, he develops the ability to solve relatively complex problems. In a 12 or 13 year old pupil the development of this intellectual process can be seen as he begins to demonstrate the following abilities:

(a) to state, when necessary, new hypotheses;

(b) to concentrate on the important aspects of a problem and not be too distracted by minor details;

(c) to make decisions.

It is, however, rather surprising to discover the mediocre quality of the questions that pupils ask themselves, even when they are placed in a practical situation involving observation and manipulation of materials. This being the case, it would seem unrealistic to expect the pupil to initiate a study activity based on questions that he has asked himself, without help from the teacher. Most pupils exhibit a certain amount of enthusiasm, but behind this lies a very limited sense of curiosity.

The transitional period of adolescence is a very important time in an individual's life for it is the point at which he begins to develop his capacity for logical thought.

### 2.2.3 Social Background

The human species does not change; it is man's ways of doing things that have evolved over the course of centuries and are still evolving. In this way man's great capacity to adapt has enabled him to deal with the adversities of climate and environment in all the areas in which he has settled.

The main distinction between man and animals lies in the degree to which man communicates with other men and is concerned with their fate. He knows how to economize when there are shortages, but, in times of prosperity, he loses sight of his values and as a result becomes wasteful and irresponsible to the point of creating an alarming and excessive rate of economic growth.

### 2.2.4 Educational Background

Environmental education is a medium that can have a very positive impact if it is centred on ecological themes and oriented toward creating a healthy environment. Environmental (mesological) education should:

- ". . . be a life-long learning process. . .
- examine the main environmental questions from a local, regional, provincial, national, and international perspective . . .
- focus on present conditions as well as on the future. . .
- examine everything that influences growth and development. . .
- stress the value and necessity of local, national, and international cooperation in order to foresee, and to find solutions to, environmental problems."[2]

1. Desjarlais, Lionel and John A. Rackauskas. ***Needs and Characteristics of Students in the Intermediate Years, Ages 12-16.*** Toronto, 1975.
2. Maldague, Michel. Op. cit. (This citation is a free translation.)

# 3. Overall Objective and Goals of the Ecology Course

## 3.1 Overall Objective of the Ecology Course

The overall objective states the main goal of the Ecology course: it forges the link between the orientations and the general objectives. It is the central purpose of the course.

THE ECOLOGY COURSE SHOULD HELP THE INDIVIDUAL TO ADAPT TO THE EVOLUTION FROM A CONSUMER SOCIETY TO A CONSERVER SOCIETY IN ACCORDANCE WITH THE PRINCIPLES WHICH GOVERN A CONSERVER SOCIETY.

## 3.2 Goals of the Ecology Course

The teaching of ecology should be concerned with the education of the whole person. It should involve not only his intelligence, but also his emotions and his will. The purpose of the course is not to condition the pupil, but to help him build a new value system based on knowledge, skills, and attitudes.

In this way, the Ecology course will help the pupil achieve the overall goal of the course which is to enable him to acquire knowledge and to develop skills and attitudes.

**(a) Knowledge and Skills:**

- to familiarize the pupil with basic ecological knowledge and the skills associated with this knowledge;
- to instill in the pupil work methods that will foster the progressive development of logical thought.

**(b) Attitudes**

- to encourage the pupil to develop positive attitudes toward himself, other people, and his environment;
- to foster intellectual discipline and self-confidence;
- to develop an understanding of nature and a sense of curiosity;
- to enable the pupil to perceive his environment in a more realistic way and with greater awareness and commitment.

# 4. Criteria for the Selection of Objectives and for the Structure of the Course

The objectives for this Ecology course have been derived primarily from the subject matter itself. Additional input has come from a number of practicing teachers and theorists, and from research studies in the fields of biology and education.

## 4.1 Criteria for the Selection of Objectives

The objectives of this course were selected on the basis of their relevance, coherence, usefulness, and humanistic values.

**(a) Relevance**

Since science and technology will play an increasingly important part in the daily lives of pupils, this factor should be taken into consideration in adapting the content of the course to ensure its relevance. The popularization of science in recent years has given science a new image. Movies and television have been instrumental in awakening young people's interest in the behaviour of living organisms, the exploitation of resources, the balance in nature, and so on.

**(b) Coherence**

The course is designed to develop three aspects of learning: knowledge (cognitive), skills, and attitudes.

A number of important facts supplement the ecological content in each module. These facts are intended to contribute to the overall understanding and knowledge: they are neither an exhaustive list of all that could be learned nor simply a number of disparate or encyclopedic data. In addition, certain aspects of man's activities have been included at appropriate places in the modules.

The learning objectives are tabulated in order of difficulty so that there is not only a progressive sequence within each module, but also from one module to the next. Thus it is easier "To identify types of relationships" (Module 1) than "To interpret types of adaptation" (Module 5).

The skills are also tabulated in order of difficulty. In a given module, they supplement the learning process, whereas, in the course as a whole, they are presented sequentially in order of difficulty from one module to another. With regard to skills related to observation. "To record phenomena (Module 1) is prerequisite to "To make comparisons" (Module 4) which, in turn, is prerequisite to "To interpret" (Module 5).

The attitude described in the heading of each module suggests a particular state of mind as the orientation for that module. The attitudes are closely linked to the other two aspects of learning. In Module 1, for example, the skill "To record the characteristics" is a specific manifestation of an attitude which should encourage the pupil "To be aware of the general characteristics of environmental phenomena" during an observation. The progressive sequence of attitudes is not very obvious, but it does, in fact, correspond to the sequence of learning. Tables 3, 4, 5, 6 show the sequence of the different types of learning.

**(c) Usefulness**

The main objective of a science course is to develop in the pupil skills and knowledge that will be useful to him and will help him to achieve a greater understanding of the relationship of cause and effect and to develop a scientific attitude which will influence his subsequent learning behaviour. The content has been organized so as to give the pupil a glimpse of certain values, to stimulate his sense of curiosity, to encourage him to examine ecological problems, and to motivate him to take a position on ecological issues.

The practical nature of the course makes it possible to provide pupils with activities which will help to develop their interest in the field of biology.

**(d) Humanistic Values**

Most of the attitudes promoted in this course focus on the individual. They are expressed as values in the form of feelings, beliefs, convictions, or a continuing willingness to behave in a conscientious way toward living beings and the things around him. By showing the pupil how man's different accomplishments are integrated into society, the course will enable the pupil to understand why he should be concerned about his community, or will show him how certain situations have already affected the living conditions of the community. This is the first step toward making a contribution to the well-being of his society.

## 4.2 Criteria for the Structure of the Course

The course has been designed as a progressive structure in the shape of a pyramid. The order of the component parts shows the interdependence of each level of the course and the relationship between each level of objectives. Table 2 illustrates the structure.

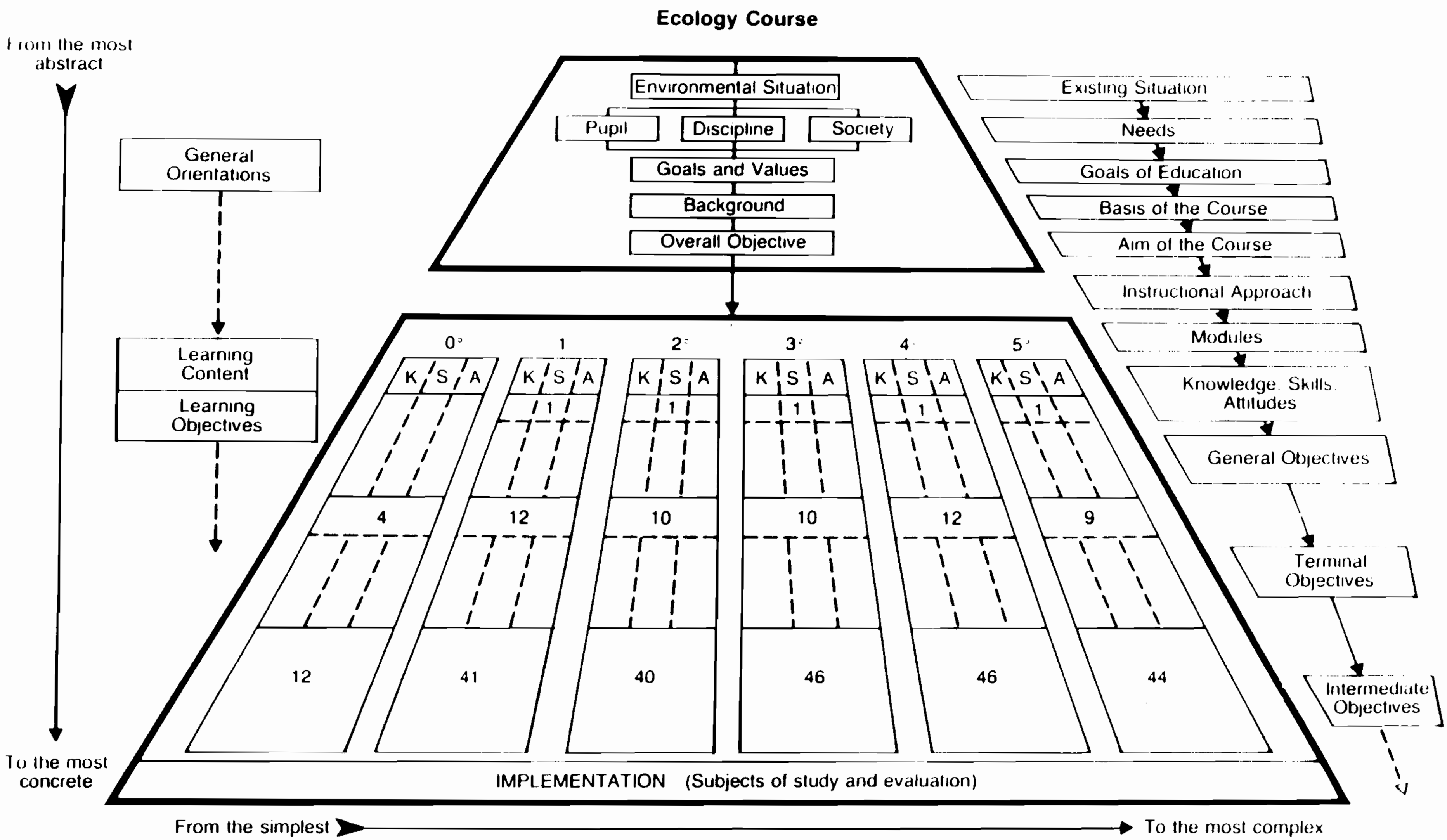



Table 2: **STRUCTURE OF THE COURSE**

## 4.3 Definition of Objectives

The general, terminal, and intermediate objectives of the course are all included under the general heading, learning objectives. "They comprise all modes of learning and all the cognitive, affective, socio-cultural, spiritual, moral, religious, and psychomotor aspects of an individual's development."[1]

To avoid any misunderstanding, the different kinds of objectives are defined as follows:

**General Objectives** (GO)

General objectives formulate the general educational goals to be achieved and the changes anticipated in the pupil.

N.B. The main proposition of each general objective comes under the category of knowledge and incorporates two complementary elements, an attitude and a skill.

Example: To know plants as organisms which play the role of producer in nature.
Attitude: To be interested in, and aware of plants and trees.
Skill: To develop different abilities.

**Terminal Objectives** (TO)

Terminal objectives are a refinement of the general objectives and describe in greater detail the results expected of pupils, in terms of "changes,"[2] by the end of a learning sequence.

N.B. The main proposition of each terminal objective comes under the category of knowledge and incorporates two complementary elements, an attitude and a skill.

Example: To identify, among examples, different forms of plant behaviour.
Attitude: To be aware of the general characteristics of environmental phenomena.
Skill: To know how to record the characteristics of a phenomenon.

**Intermediate Objectives** (IO)

Intermediate objectives describe a behaviour or a learning achievement which leads to the attainment of a terminal objective.

Example: To describe the phenomenon of a plant's response to light.

## 4.4 Rules for Formulating Objectives

All learning objectives should conform to three basic criteria:

They must:

(a) *be formulated in terms of the pupil*.
Example: *The pupil* should be able to . . .

(b) *include an action verb*.
This verb should describe explicitly a measurable and observable behaviour.
Example: *To distinguish* different types of interactions that occur in the environment.

(c) *include content*.
N.B. The objective deals with learning, not learning situations.
Example: To distinguish the different types of *interactions that occur in the environment*.

Supplementary criteria for formulating objectives (context and performance) are not, for the most part, specified here. The teacher has the responsibility of determining these to suit his needs.

## 4.5 General Objectives of the Ecology Course

The main aim of this course is to educate the pupil. The general objectives, in addition to providing the ecological content, are concerned with attitudes and skills which will correlate the overall goal with the content.

1. To know various forms and functions of life.
   Skill: To develop different abilities (dexterity).
   Attitude: To have a sense of wonder about environmental phenomena (sense of curiosity).

2. To know the plant as an organism which plays the role of producer in nature.
   Skill: *To develop* different abilities (dexterity).
   Attitude: *To be interested in, and aware of* plants and trees (sense of curiosity).

3. To know the animal as an organism which plays the role of consumer in nature.
   Skill: *To develop* different abilities (resourcefulness).
   Attitude: *To be interested in, and aware of* all animals, large and small (sense of curiosity).

1. Québec. Ministère de l'Éducation. Direction générale du développement pédagogique. *Cadre relatif à l'élaboration des programmes et des guides pédagogiques*. 4th ed., April 1980, pp. 15-17. (This citation is a free translation.)
2. The word "change" in this context covers every aspect of learning and all cognitive, affective, social, psychomotor, and attitudinal changes expected of the pupil.

## Skills

| | Module 1 | Module 2 | Module 3 | Module 4 | Module 5 |
|---|---|---|---|---|---|
|  | To know how to record the specific characteristics of a phenomenon. | To know how to record the specific characteristics of a phenomenon.<br><br>To know how to state assumptions on the basis of a demonstration or set-up | To know how to record the specific characteristics of a phenomenon.<br><br>To know how to state or formulate assumptions on the basis of a demonstration or a set up | To know how to record characteristics for making comparisons | To know how to record specific data in the form of drawings and notes<br><br>To know how to analyze patterns of movement<br><br>To know how to interpret an observed fact |
|  | To know how to take a measurement.<br><br>To know how to take a precise reading on an instrument.<br><br>To know how to follow a procedure. | To know how to choose a simple procedure to verify a given assumption.<br><br>To know how to list the steps of an experiment in the correct order.<br><br>To know how to coordinate observations made over a period of time.<br><br>To know how to construct a graph based on two variables. | To know how to choose a simple procedure to verify assumptions.<br><br>To know how to compile data over a period of time.<br><br>To know how to predict the shape of a graph. | To know how to interpret the results of an experiment. | To know how to interpret the results of an experiment<br><br>To know how to recognize whether or not an assumption is confirmed by the results<br><br>To know how to relate a series of observations made over a period of time. |
|  | To know how to select the passage in a reference book which answers a specific question. | To know how to answer a specific question with the aid of reference material (books, films, . . . ). | To know how to answer a specific question with the aid of a reference material (books, films, ) | To know how to diagram correctly the steps in a process.<br><br>To know how to use symbols.<br><br>To know how to answer a question, using a table or a diagram. | To know how to find an explanation of a phenomenon on his own<br><br>To know how to establish the truth of his arguments with the aid of reference materials (books, films, |
|  | To know how to solve a problem through discussion or dialogue. | To know how to solve a problem through discussion or dialogue. | To know how to solve a problem through discussion or dialogue | To know how to solve a problem through discussion or dialogue<br><br>To know how to carry out a project. | To know how to solve a problem through discussion or dialogue<br><br>To know how to carry out a project. |

TABLE 5: **The Modules of the Course**

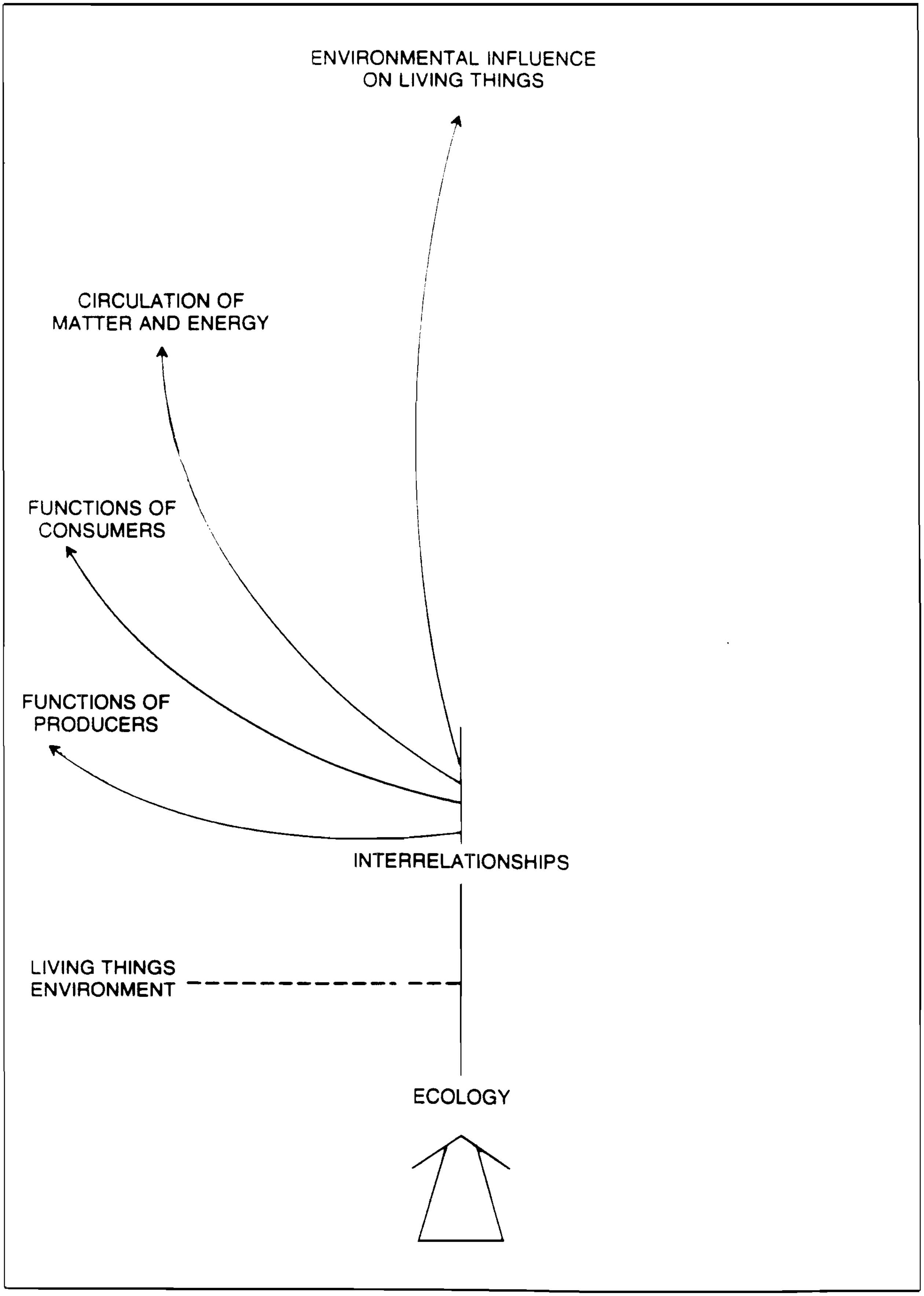


TABLE 6: **Description of Modules**

| MODULES | |
|---|---|
| 0° ECOLOGY | Science which studies the interrelationships of living organisms and the environment (organisms and environment include man and his environment). |
| 1° INTERRELATIONSHIPS | All observed phenomena of the interaction between living organisms, and between living organisms and nonliving things, or the forms and functions of life. |
| 2° FUNCTIONS OF PRODUCERS | All the different activities of plants which ensure their survival, or how plants use time and space. |
| 3° FUNCTIONS OF CONSUMERS | All the different activities of animals which they carry out to ensure their survival, or how animals use time and space. |
| 4° CIRCULATION OF MATTER AND ENERGY | The importance of cycles and systems, or how producers and consumers exchange matter and energy. |
| 5° ENVIRONMENTAL INFLUENCES ON LIVING ORGANISMS | The success of an organism in adapting to its environment, or how living organisms adapt to the characteristics of nonliving things. |

# 6. Content

## Ecology (Introduction)

| Skill | Attitude: To be aware of the general characteristics of environmental phenomena | Learning Content |
|---|---|---|
|  | * T.O. 0.1 **To give** a definition of the word "ecology" | Science which examines all the relationships between living things and their environment. A biological science which seeks to learn about life |
| | * 0.1.1 **To give** possible interpretations of the expression "ecological relationship." | Relationship, need for, dependent upon influences. |
| | * 0.1.2 **To give** a simple definition of the expression "natural environment" | A unit of nature which comprises living and nonliving things involved in a variety of activities |
| | * 0.1.3 **To give** a definition of the expression "surrounding community" | A natural or artificial environment which includes man |
| **To be able to recognize** the limitations of sensory perceptions. | * T.O. 0.2 **To give** a modified definition of the expression "scientific method" | A scientific method of work which involves carrying out specific activities to lead to discovery, or an intellectual approach which involves carrying out a series of activities to lead to the solution of a particular problem |
| | 0.2.1 **To name** activities which would combine to create a suitable working method for ecology. | Observation, experimentation, consultation or reference material, communication |
| **To know how to record** similar and dissimilar characteristics. | T.O. 0.3 **To identify** the members of the living part of the environment | Producer, consumer, decomposer |
| | 0.3.1 **To name** the characteristics of a living organism | Capable of movement, feeding, growth, reproduction, respiration |

* This objective may be introduced at any time.

| | |
|---|---|
| 0.3.2 **To distinguish** between living and nonliving things. | |
| 0.3.3 **To classify** about twenty given things into two categories: living and non-living. | |
| 0.3.4 **To give** a simple definition of the word "producer." | A living organism which utilizes non-living substances and transforms them into living matter. |
| 0.3.5 **To give** a simple definition of the word "consumer." | A living organism which seeks and utilizes food for its activities and movements. |
| 0.3.6 **To give** a simple definition of the word "decomposer." | A living organism which utilizes living matter and transforms it into non-living matter. |
| T.O. 0.4 **To give** a simple definition of the word "species." | Two organisms are of the same species if male and female can reproduce and produce viable offspring similar to themselves. |
| 0.4.1 **To distinguish**, among plant specimens, those whose leaves are simple or compound, smooth or serrated, lobed or unlobed. | |
| 0.4.2 **To distinguish**, among animal specimens, those that have different profiles of the head, limbs, or body. | |

## 1° Interrelationships

**GENERAL OBJECTIVE:** TO KNOW VARIOUS FORMS AND FUNCTIONS OF LIFE

**Skill:** To develop different abilities (dexterity).

**Attitude:** To have a sense of wonder about environmental phenomena (sense of curiosity).

| Skill | | Learning Content |
|---|---|---|
|  | **Attitude:** To be aware of the general characteristics of environmental phenomena | |
| **To know how to record** the specific characteristics of a phenomenon. | T.O. 1.1 **To distinguish** the different types of interactions that occur in the environment. | Living/living relationships. Nonliving/living relationships. Living/nonliving relationships |
| | 1.1.1 **To identify** among examples, a living/living relationship | |
| | 1.1.2 **To identify** among examples, a nonliving/living relationship. | |
| | 1.1.3 **To identify** among examples, a living/nonliving relationship. | |
| | 1.1.4 **To define** the word "phenomenon" | A form or function in the environment |
|  | **Attitude:** To be willing to take an investigative approach | |
| **To know how to take** a measurement. **To know how to take** a precise reading on an instrument. **To know how to follow** a procedure. **To know how to construct** a histogram or graph | T.O. 1.2 **To name** the characteristics of nonliving elements | |
| | 1.2.1 **To identify** the properties of air. | Temperature, wind, humidity. |
| | 1.2.2 **To identify** the properties of water | Temperature, transparency, flow. |
| | 1.2.3 **To identify** the properties of light | Luminosity, reflection. |
| | 1.2.4 **To identify** the properties of soil | Air, water, organic matter, mineral salts. |
| | 1.2.5 **To determine** the percentage of water retained in soil | |
| | 1.2.6 **To determine** the percentage of organic matter in soil. | |
| | 1.2.7 **To determine** the percentage of air retained in soil | |
| | 1.2.8 **To determine** the presence or absence of mineral salts in soil. | |

| T.O. 1.3 | **To give** the reasons why the presence of organic matter in the soil is important in plant cultivation. |
|---|---|

Water retention, soil aeration, soil enrichment, . . .

1.3.1 **To determine**, by means of an experiment, the water retention capacity of organic matter (humus).

| T.O. 1.4 | **To identify** the harmful effects that various polluting agents suspended in the air or in water can have on man's health. |
|---|---|

1.4.1 **To identify** one of the differences between "natural air" and "polluted air."

Presence of foreign particles, . . .

1.4.2 **To determine** the qualitative value of different air samples collected around the school or elsewhere.

1.4.3 **To identify** one of the differences between "natural water and "polluted water."

Presence of foreign particles, . . .

1.4.4 **To determine** the qualitative value of different water samples collected in the area.

1.4.5 **To identify** toxic substances which cause pollution if they are present in the air or in water.

**Attitude:** To be willing to follow a structured approach in consulting reference material.

**To know how to select** the passage in a reference material which answers a specific question.

| T.O. 1.5 | **To identify**, from examples, phenomena of living/living relationships. |
|---|---|

Predation, parasitism, commensalism, mutualism, . . .

1.5.1 **To illustrate** some phenomena of predation.

1.5.2 **To distinguish** between prey and predator.

1.5.3 **To illustrate** some phenomena of parasitism.

1.5.4 **To distinguish** between host and parasite.

1.5.5 **To illustrate** some phenomena of commensalism.

1.5.6 **To illustrate** one phenomenon of competition.

1.5.7 **To illustrate** one phenomenon of mutualism.

| | | |
|---|---|---|
| T.O. 1.6 | **To identify**, from examples, phenomena of nonliving/living relationships | Windfalls, withering, heliotropism, geotropism, cracks caused by frost, contamination. |
| 1.6.1 | **To name** some of the natural phenomena which can cause a windfall | Tree(s) naturally felled by the wind, the weight of snow, frost, running water, earth tremors, or age |
| 1.6.2 | **To name** some of the phenomena which can cause withering of trees or plants | Heat, cold, wind, water |
| 1.6.3 | **To give** a simple reason for the phenomenon of heliotropism in a given plant. | Attraction to light |
| 1.6.4 | **To give** a simple reason for the phenomenon of geotropism in a given plant | Gravity. |
| 1.6.5 | **To give** a simple reason for the phenomenon of hydrotropism | Attraction to water |
| T.O. 1.7 | **To identify**, from examples, phenomena of living/nonliving relationships | Burrowing, engineering skill, periodicity, migration. |
| 1.7.1 | **To give** a simple reason for the burrowing action of a given animal | Hiding place, search for food |
| 1.7.2 | **To give** a simple reason for a phenomenon of engineering of a given animal | |
| 1.7.3 | **To name** factors which contribute to the falling of leaves in autumn | Light, temperature |
| 1.7.4 | **To name** factors which contribute to the migration of a given bird | Light, food, temperature |
| T.O. 1.8 | **To identify**, from examples, phenomena of living/human relationships | Hunting, fishing, agriculture, breeding and raising livestock, forestry |
| 1.8.1 | **To name** species of animals taken from the sea for use as food. | |
| 1.8.2 | **To name** species of trees commonly used in paper production | |

1.8.3 **To name** species of trees commonly used in construction.

1.8.4 **To identify** acts of vandalism which occur in public parks.

Damage to the bark of trees, bird hunting, . . .

T.O. 1.9 **To identify**, from examples, phenomena of nonliving/human relationships.

Intoxication, diseases, . .

1.9.1 **To name** substances which may be dangerous to health if inhaled.

Insecticides, herbicides, industrial wastes, . . .

1.9.2 **To name** substances which may be dangerous to health if absorbed.

T.O. 1.10 **To identify**, from examples, phenomena of human/nonliving relationships.

Industrialization (construction, manufacture), mining, . . .

1.10.1 **To name** mining products used in home construction.

**Attitude:** To be willing to re-examine objectively the ways in which he uses environmental resources.

**To know how to solve** a problem through discussion or dialogue.

T.O. 1.11 **To investigate** ways in which man can benefit from the use of water, air, soil, fauna, and flora.

Activities essential to our way of life.

— use of soil (agriculture, livestock, . . .)

— use of green spaces (recreation, leisure, . . .)

T.O. 1.12 **To investigate** the risks and dangers involved in detrimental use of water, air, and soil.

Pollution, contamination, depletion of resources, environmental degradation, . . .

## 2° The Functions of Producers

**GENERAL OBJECTIVE:** TO KNOW THE PLANT AS AN ORGANISM WHOSE ROLE IN NATURE IS THAT OF PRODUCER.

**Skill:** To develop different abilities (dexterity).

**Attitude:** To be interested in, and aware of, plants and trees (sense of curiosity).

**Skill** | **Learning Content**

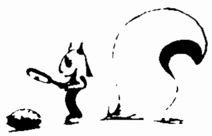
**Attitude:** To be aware of the general characteristics of environmental phenomena.

| Skill | Objective | Learning Content |
|---|---|---|
| **To know how to record** the specific characteristics of a phenomenon. | T.O. 2.1 **To identify**, from examples, different forms of plant behaviour. | Heliotropism, phototropism, geotropism, hydrotropism, . . |

2.1.1 **To describe** the response of a plant (leaf and stem) to light.

2.1.2 **To describe** the response of a plant (root) to soil.

2.1.3 **To describe** the response of a plant (root) to water.



**Attitude:** To be able to ask himself questions.

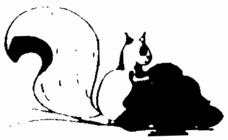
| Skill | Objective | Learning Content |
|---|---|---|
| **To know how to state** assumptions on the basis of a demonstration or set-up. | T.O. 2.2 **To identify** the nonliving elements required for the process of assimilation in plants. | Carbon dioxide, water, mineral salts, light. |

2.2.1 **To explain** the importance of water for a green plant.

2.2.2 **To explain** the importance of light for a green plant.

2.2.3 **To explain** the importance of carbon dioxide for a green plant.

2.2.4 **To explain** the importance for a green plant of mineral salts dissolved in water.



**Attitude:** To be willing to take an investigative approach.

**To know how to choose** a simple procedure to verify a given assumption.

**To know how to list** the steps of an experiment in the correct order.

T.O. 2.3 **To explain**, in a simple manner, the function of chlorophyll.

Water + $CO_2$ + light ⟶ sugar + oxygen

2.3.1 **To discover**, by means of an experiment, a source of oxygen production.

2.3.2 **To discover**, by means of an experiment, the presence of energy in a plant.

2.3.3 **To discover**, by means of an experiment, the influence of light on the production of carbon dioxide and oxygen in a plant.

2.3.4 **To discover**, by means of an experiment, the influence of light on leaf colouration.

2.3.5 **To discover**, by means of an experiment, the role of the stem and the root in absorbing water.

2.3.6 **To discover**, by means of an experiment, the presence of chlorophyll in a leaf.

2.3.7 **To discover**, by means of an experiment, the presence of sugar (starch) in a plant.

2.3.8 **To discover**, by means of an experiment, the presence of mineral salts in a plant.

T.O. **To explain**, in a simple manner, the general reaction for respiration

Sugar + oxygen ⟶ carbon dioxide + water + heat

2.4.1 **To discover**, by means of an experiment, the presence of water vapor and carbon dioxide.

2.4.2 **To discover**, by means of an experiment, a source of carbon dioxide production.

2.4.3 **To give** a simple explanation of how wood burns.

Wood + high heat ⟶ creosote
creosote + oxygen ⟶ flame + + smoke + water vapor

2.4.4 **To discover**, by means of an experiment, the phenomenon of transpiration in a plant.

**Attitude:** To be willing to take an investigative approach.

| **To know how to coordinate** observations made over a period of time. **To know how to construct** a graph based on two variables. |
|---|

| T.O. 2.5 | **To identify** the main stages in the germination and growth of a plant. |
|---|---|

2.5.1 **To discover**, by means of an experiment, the importance of water and light to the growth of a plant.

2.5.2 **To discover**, by means of an experiment, the role of cotyledons during the germination of a bean.

2.5.3 **To discover**, by means of an experiment, the effect of a hormone on the growth of a plant.

2.5.4 **To identify** the following parts in a bean that has been cut in half: embyro, plumule, . . .

**Attitude:** To be willing to follow a structured approach in consulting reference material.

| **To know how to answer** a specific question with the aid of reference material (books, films, . . .) |
|---|

| T.O. 2.6 | **To identify** the principles which govern a given plant's use of time and space. |
|---|---|

Growth, reproduction, energy assimilation, adaptation to climate, competition.

2.6.1 **To explain** the role of leaves, flowers, roots, and the stem in the growing cycle of a given plant.

Absorption, respiration, transpiration

Absorption of water

Food storage or reserve in the form of wood

2.6.2 **To explain** the role of colonizing plants in a given environment.

Ensure plant succession.

| T.O. 2.7 | **To explain**, using resource material, the reproduction activities of a given flowering plant. |
|---|---|

Pollination, fruit formation, seed dispersal.

2.7.1 **To explain** the role of the flower in plant reproduction.

Fertilization, fruit formation.

| | | |
|---|---|---|
| 2.7.2 | **To describe** the simple phenomenon of fertilization of a flowering plant. | |
| 2.7.3 | **To identify** pollinating agents. | Wind, insects, man, . . . |
| 2.7.4 | **To identify** seed-dispersing agents. | Wind, animals, insects, water, . . . |
| T.O. 2.8 | **To identify** ways in which agricultural and forestry activities benefit the community. | |
| 2.8.1 | **To identify** the prime source of energy on earth. | |
| 2.8.2 | **To identify** important sources of carbon dioxide production in a given community. | Fuel-burning equipment, human respiration, . . . |
| 2.8.3 | **To identify** important sources of oxygen in a given community. | Plants, trees, . . . |
| 2.8.4 | **To identify** the main steps in the cultivation of cereal plants. | Soil preparation, sowing, plant maintenance and protection, harvesting |
| 2.8.5 | **To identify** the edible part(s) of plants, from a list of plants. | |
| 2.8.6 | **To name** plants produced on a farm which do not need to be processed before consumption. | |
| 2.8.7 | **To name** plants produced on a farm which have been processed for consumption. | |
| 2.8.8 | **To draw up a list** of products which man obtains from a given vegetable or fruit. | |
| 2.8.9 | **To draw up a list** of products which man obtains from a given tree or plant. | |

**Attitude:** To be willing to re-examine objectively the ways in which he uses plants to satisfy his needs.

**To know how to solve** a problem through discussion or dialogue.

| | | |
|---|---|---|
| T.O. 2.9 | **To investigate** ways in which man can benefit from the use of plants | Improved quality of life, satisfaction of needs: food, clothing, construction, medication, decoration, . . . |
| T.O. 2.10 | **To investigate** the risks and dangers involved in excessive exploitation of plants. | Environmental degradation, depletion of soil minerals, over-production. |

## 3° The Functions of Consumers

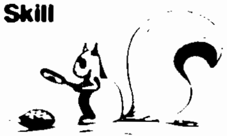
**GENERAL OBJECTIVE:** TO KNOW THE ANIMAL AS AN ORGANISM WHOSE ROLE IN NATURE IS THAT OF CONSUMER

**Skill:** To develop different abilities (dexterity).

**Attitude:** To be interested in, and aware of, all animals, large and small (sense of curiosity).

**Skill**

**Learning Content**



**Attitude:** To be aware of the general characteristics of environmental phenomena.

**To know how to record** the specific characteristics of a phenomenon.

T.O. 3.1 **To identify**, from examples, social interactions between individual members of a given population.

Relationships within a group: dominance, hierarchy, ...

Parent-offspring relationships: care, feeding, games, learning.

Male-female relationships: selection, territory, ...

3.1.1 **To describe** a phenomenon of dominance.

3.1.2 **To describe** a phenomenon of hierarchical order.

3.1.3 **To identify** ways in which the individual members benefit from social communication within a population.

Identification of self to others, revealing of intentions, ...

3.1.4 **To describe** a phenomenon of parent-offspring relationships.

3.1.5 **To describe** a phenomenon of male-female relationships.

3.1.6 **To define** the word "population."

Group of individuals of the same species living in a specific location.

T.O. 3.2 **To identify**, from examples, different social relationships between humans.

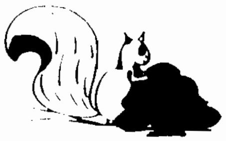
Cooperation, competition, independence, exploitation.

3.2.1 **To name** some of the advantages of community life for the human species.

**Attitude**: To be able to ask himself questions

**To know how to state** assumptions on the basis of a demonstration or set-up.

| | | |
|---|---|---|
| T.O. 3.3 | **To classify** examples of different cyclical activities observed for given animals, according to daily, seasonal, and annual rhythms. | Daily activities search for food, rest, grooming, cry or song.<br>Seasonal activities change of habitat, change of food, change in appearance<br>Annual activities mating, reproduction |
| 3.3.1 | **To name** characteristic movements made by a given animal in its search for food. | Using sense of smell, using sense of sight. |
| 3.3.2 | **To name** ritual grooming patterns of a given animal. | Licking of whiskers, abdomen |
| 3.3.3 | **To name** characteristic movements made by a given animal when exploring a new environment. | Mobile exploration, stationary exploration. |
| 3.3.4 | **To name** characteristic movements made by a given animal to maintain balance. | Balance or counterbalance, using tail or nose. . |
| 3.3.5 | **To name** characteristic movements made by given animals during migration. | Movement pattern, position of young in a herd, position of dominant animals in a herd. . . |
| 3.3.6 | **To name** characteristic reactions of two animals of the same species when they meet. | Acceptance, mating, rejection, fighting. . . . |
| 3.3.7 | **To name** characteristic reactions of a given cold-blooded animal during hibernation. | Sluggishness, slower respiratory rhythm, . . |
| 3.3.8 | **To name** ways in which warm-blooded animals resist winter | Migration, sleep, thickening of fur |
| 3.3.9 | **To distinguish** between "hibernation" and "wintering." | |



**Attitude:** To be willing to take an investigative approach.

| | | |
|---|---|---|
| **To know how to choose** a simple procedure to verify assumptions. | T.O. 3.4 **To identify** ways in which learning may influence the behaviour of a given animal. | Learning: modifies instinctive actions, brings about observable changes, improves certain other learned actions. |
| | 3.4.1 **To distinguish** "innate behaviour" and "learned behaviour." | Innate behaviour: instinctive action inherent at birth. Learned behaviour: action learned from experience. |
| | 3.4.2 **To identify** modes of learning. | Repetition, trial and error, copying, |
| | 3.4.3 **To discover**, by means of an experiment, the learning capacity of a given animal confronted with choices (e.g.: colours, obstacles, . . .). | |
| | 3.4.4 **To give** the meaning of the word "stimulus" when it is used in connection with a learning activity. | Trigger, excitation in response to signals, . . . |
| | 3.4.5 **To discover**, by means of an experiment, a given animal's preference for light or darkness. | Attraction or flight, . . . |
| | 3.4.6 **To discover**, by means of an experiment, a given animal's preference for high or low temperatures. | |
| | 3.4.7 **To discover**, by means of an experiment, a given animal's preference for a dry or wet environment. | |
| | 3.4.8 **To discover**, by means of an experiment, a given animal's preference for a complex or simple environment. | Example of a complex environment: a cage filled with obstacles. Example of a simple environment: an empty cage. |

**Attitude:** To be willing to take an investigative approach

**To know how to compile** data over a period of time

T.O. 3.5 **To identify** the different parts of an animal s body.

**To know how to predict** the shape of a graph.

3.5.1 **To identify** factors which affect the growth of an animal.

Abundance or deficiency of food or water.

3.5.2 **To discover**, by means of an experiment, the importance of food and water to the growth of an animal.

**Attitude:** To be willing to follow a structured approach in consulting reference material.

**To know how to answer** a question with the aid of reference material (books, films, . . .)

T.O. 3.6 **To identify** the principles which govern a given animal's occupation of space.

Resources, economy of energy, complete familiarity with living space.

3.6.1 **To define** the term "living space."

The home: the region the animal knows very well and spends time in each day.

3.6.2 **To identify** the elements that make up the living space of a given animal.

1 main shelter, 3 4 secondary shelters, sources of drinking water, adequate food supply, pathways, . . .

3.6.3 **To describe** the shelter of a given species.

Cave, burrow, debris, hole, beaver lodge, nest, . . .

3.6.4 **To associate** given species with their shelters.

3.6.5 **To define** the word "territory."

Space which an animal will defend to the limit.

3.6.6 **To name** a means used by a given animal to establish his territory.

Cry, song, marking, fighting.

3.6.7 **To indicate**, using a given book, the features of the habitat of a given animal.

Habitat, shelter, territory, living space

3.6.8 **To associate** a given type of movement with a body part.

Webbed feet swimming
hooves running
fingers gripping
wings flying
powerful hind legs jumping

| | |
|---|---|
| T.O. 3.7 | **To identify**, using a book, activities which show how a given animal's time is organized. |

Daily activities, seasonal activities, annual activities

3.7.1 **To associate** various forms of beak or mouth with a given food diet.

3.7.2 **To give** some of the elements which characterize the food diet of:
1. a herbivore
2. a carnivore
3. a decomposer or scavenger
4. an omnivore.

Foods: meat, fruit, vegetables, carcasses, . . .

3.7.3 **To distinguish** the mouth of a carnivore, the mouth of a herbivore (ruminant), and the mouth of a herbivore (gnawer).

3.7.4 **To distinguish** the beak of a carnivorous bird (predator) and the beak of an insect-eating bird (or the beak of a granivore and the beak of an omnivore).

3.7.5 **To differentiate** between bird reproduction and mammalian reproduction.

3.7.6 **To describe** the behaviour of a given animal in a particular situation.

Displaying, mating, grooming.

3.7.7 **To name** three important stages in satisfying a specific need (e.g., eating).

Stages:
1. search,
2. accomplishment or satisfaction,
3. rest.

| | |
|---|---|
| T.O. 3.8 | **To identify** factors linked to human activity which have, or could have, a positive or negative effect on fauna. |

3.8.1 **To identify** animal species saved from extinction by man's intervention.

3.8.2 **To identify** endangered animal species.

| | | |
|---|---|---|
| | 3.8.3 **To identify** negative actions which could endanger a given species. | Uncontrolled hunting, pollution, destruction of habitats, . . . |
| | 3.8.4 **To name** positive factors which could assure the survival of a given species. | Wildlife reserves, scientific studies. |
| | 3.8.5 **To draw** up a list of products obtained from the carcass of a given animal. | |
|  | **Attitude:** To be willing to re-examine objectively the ways in which he uses animals to satisfy his needs. | |
| **To know how to solve** a problem through discussion or dialogue. | T.O. 3.9 **To investigate** the ways in which man can benefit from the use of animals. | Improved quality of life, food, clothing, recreation, economic investment. |
| | T.O. 3.10 **To investigate** the risks and dangers involved in excessive exploitation of animals. | Decrease in animal population, overproduction, overexploitation, . . . |

## 4° Circulation of Matter and Energy

**GENERAL OBJECTIVE:** TO KNOW THAT IN NATURE NOTHING IS LOST AND NOTHING IS CREATED.

**Skill:** To develop different abilities (resourcefulness).

**Attitude:** To be aware of the balance in nature (understanding of nature).

**Skill** | **Learning Content**

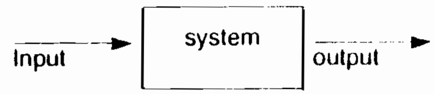
**Attitude:** To be aware of the details of environmental phenomena.

**To be able to record** characteristics for making comparisons.

T.O. 4.1 **To explain**, in a simple manner, the general energy transfer reaction.

Energy work + heat

4.1.1 **To identify** the inputs and outputs of a given system.




4.1.2 **To identify** the components of a simplified model of a system.


4.1.3 **To compare** an internal combustion engine and a living organism, using a model of a system.

4.1.4 **To identify** the components of a natural closed system e.g., an aquarium.

4.1.5 **To identify** the components of an open system e.g., a lake.

**Attitude:** To be willing to take an investigative approach.

**To know how to interpret** the results of an experiment.

T.O. 4.2 **To name** the basic principles of energy transfer.

Energy changes from one form to another. There is always loss of heat during a transfer of energy.

4.2.1 **To discover**, by means of an experiment, "the different forms of energy loss in an animal."

4.2.2 **To give** a simple definition of the word "biomass

Accumulated matter in one or more organisms at a given time

4.2.3 **To determine**, in percentage form, the net productivity of an organism from given data on gross productivity and measurable loss

Gross productivity loss net productivity. (The net productivity is estimated at approximately 10%).

**Attitude:** To be willing to follow a structured approach in consulting reference material.

**To know how to diagram** correctly the steps in a process.

**To know how to use** symbols.

T.O. 4.3 **To define** the expression "circulation of matter."

Circulation exchange or transfer

4.3.1 **To identify** the following phenomena on a diagram of the water cycle evaporation, transpiration, condensation, precipitation, run-off.

4.3.2 **To identify** the following phases on a diagram of the carbon cycle: release of carbon dioxide, photosynthesis, respiration, release of oxygen, sugar production (foods).

4.3.3 **To give** a simple definition of the word "respiration."

4.3.4 **To show** the relationship between "respiration" and "combustion."

4.3.5 **To give** a simple definition of the word "photosynthesis."

"Photo" means "light"
"syn" means "with"
"thesis" means "putting together."

T.O. 4.4 **To name** substances in which energy is stored.

Natural gas, oil, peat, . . .

4.4.1 **To identify** sources of energy other than fossil fuels.

Wood, peat, manure, wind, sun, . .

4.4.2 **To associate** sources of energy with given needs.

E.g. heating of homes with coal, oil, natural gas, electricity, . .

**T.O. 4.5** **To identify** the following links on a diagram showing the food chain of a terrestrial environment: producer, herbivore (1st level consumer), carnivore (2nd level consumer), and decomposer (3rd level consumer).

4.5.1 **To give** a working definition of the word "producer."

A green plant which is capable of capturing light energy and transforming it into sugar (chemical energy).

4.5.2 **To give** a working definition of the word "herbivore."

A consumer which is capable of deriving its sustenance from producers (green plants).

4.5.3 **To give** a working definition of the word "carnivore."

A consumer which is capable of deriving its sustenance from either a herbivore or another carnivore.

4.5.4 **To give** a working definition of the word "decomposer."

A consumer which is capable of deriving its sustenance from wastes and carcasses and returning a variety of nonliving matter to the environment.

4.5.5 **To list**, in order, given organisms of a forest environment on a diagram of a food chain.

4.5.6 **To name** organisms that might be hunted by a given predator.

4.5.7 **To define** the word "to need."

To be dependent on.

**Attitude:** To be willing to follow a structured approach in consulting reference material.

**To know how to answer** a question, using a table or diagram.

**T.O. 4.6** **To identify** the following components on a diagram of an ecological system: energy input, producers, herbivores, carnivores, wastes, decomposers, loss.

4.6.1 **To identify**, among examples, a pyramid based on numbers.

4.6.2 **To identify**, among examples, a pyramid based on mass (according to an estimated 10% productivity).

4.6.3 **To identify** the trophic levels of an environment

Trophic levels
1 producers
2 primary consumers
3 secondary consumers
4 tertiary consumers

4.6.4 **To compare** the trophic levels of a natural, semi natural, and artificial environment.

4.6.5 **To determine**, from a model of an ecological system, the biomass of each link in the food chain (based on 10% productivity).

4.6.6 **To define** the word "ecosystem."

Any unit of nature that includes living organisms and nonliving matter which, in interacting, bring about exchanges of matter and energy

| | |
|---|---|
| T.O. 4.7 | **To give** a definition of the word "recycling." |

4.7.1 **To identify** a mechanism for recycling wastes (solid or liquid) on a diagram of a city layout.

4.7.2 **To identify** a mechanism for recycling organic matter on a diagram of a farm layout.

4.7.3 **To identify** sources of energy waste in the form of heat.

| | |
|---|---|
| T.O. 4.8 | **To compare** the food supply systems of a given indigenous population and a given urban population. |

4.8.1 **To construct** an energy chain for a given food.

E.g. sun ► grass ►
cow ► milk

4.8.2 **To represent**, by means of a flowchart, the system for marketing a given food.

Farm ► wheat
mill ► flour
bakery ► bread
grocery store

| | | |
|---|---|---|
| 4.8.3 | **To represent**, by means of a flowchart, the input of matter and energy required to market a given food product. | |
| 4.8.4 | **To identify** ways in which over-consumption of products is promoted. | Advertising, . . . |
| T.O. 4.9 | **To identify**, on a food chain diagram, the transfer of toxic substances which man has released into the environment. | |
| 4.9.1 | **To identify** a way in which man controls the increase of competitive species. | Chemical spraying, . . . |
| 4.9.2 | **To identify** a way in which man protects the development of useful species. | Selective spraying, . . |
| 4.9.3 | **To identify** nonbiodegradable substances which can circulate in the food chain. | D.D.T., mercury, . . . |
| 4.9.4 | **To identify** techniques used in biological control. | Selected predators, selected parasites, . . . |
| 4.9.5 | **To identify** toxic substances which endanger man's health. | Chlorine, cyanide, . . . |
| 4.9.6 | **To name** methods suggested for eliminating toxic wastes. | Incineration, solidification, safe burial, . . . |
| T.O. 4.10 | **To explain**, using a table showing the prey-predator relationship, a fluctuation in population at a given time. | Surplus or shortage causes an increase or decrease in population. |
| 4.10.1 | **To determine** the density of a population according to the formula D = N/S. | D = density,<br>N = number of individuals,<br>S = given space occupied. |
| 4.10.2 | **To determine**, from a sample and the formula N = S × D, the number of individuals in a given population. | |
| 4.10.3 | **To define** the expression "carrying capacity." | Quantity of food available in a given place. |
| 4.10.4 | **To explain** the consequences of too large a population of consumers in a limited space. | Degradation of the habitat, decline in number of individuals, . . . |

4.10.5 **To show** the relationship between "carrying capacity" and "population density."

**Attitude:** To be willing to re-examine objectively the ways in which he uses energy and resources.

**To know how to solve** a problem through discussion or dialogue.

**To know how to carry** out a project.

| | | |
|---|---|---|
| T.O. 4.11 | **To investigate** ways in which man can benefit from the use of energy and resources. | Progress, development, improved quality of life, . . . |
| T.O. 4.12 | **To investigate** the risks and dangers involved in excessive exploitation of resources and energy. | Over-consumption, waste, . |

## 5° Environmental Influences on Living Organisms

**GENERAL OBJECTIVE:** TO KNOW THE REASONS FOR THE SURVIVAL AND PROLIFERATION OF AN ORGANISM.

**Skill:** To develop different abilities (resourcefulness).

**Attitude:** To be aware of the dimension of harmony in the environment (understanding of nature).

| Skill | | | Learning Content |
|---|---|---|---|
|  | | **Attitude:** To be aware of the details of environmental phenomena. | |
| **To know how to record** specific data in the form of drawings, notes, . . . | T.O. 5.1 | **To explain** how the structure of a given animal enables it to carry out its activities. | Organization of time, reproduction, feeding, use of space, movement, |
| **To know how to analyze** patterns of movement. | 5.1.1 | **To describe** the action that comes to mind on observing the incisors of a given gnawing animal. | Tearing |
| **To know how to interpret** an observed fact. | 5.1.2 | **To describe** the action that comes to mind on observing the webbed feet of a duck or frog. | Swimming |
| | 5.1.3 | **To describe** the position of a frog's limbs while swimming. | |
| | 5.1.4 | **To describe** the position of a fish's body while swimming. | |
| | 5.1.5 | **To describe** the action that comes to mind on observing the powerful hind legs of a hare. | Jumping |
| | 5.1.6 | **To describe** the position of a hare's limbs when it jumps. | Extended. |
| | 5.1.7 | **To describe** the action that comes to mind on observing the thumb of a hand. | Gripping<br>e.g. squirrel, raccoon, monkey, man. |
| | 5.1.8 | **To describe** the position of the thumb when it grips. | Thumb is at 90° angle to the fingers |

| | |
|---|---|
| 5.1.9 **To describe** the action that comes to mind on observing the hooves of a quadruped. | Running, galloping, . . . |
| 5.1.10 **To describe** the position of the hooves in relation to the ground when running. | |
| 5.1.11 **To describe** the position of a given bird's wings when flying. | Stretched out, . . . |
| 5.1.12 **To explain** the importance of a fur coat to an animal. | Resists cold or heat, . . |
| 5.1.13 **To describe** the action that comes to mind on observing a cat's claws. | Climbing. |

| | |
|---|---|
| T.O. 5.2 | **To explain** how the particular structure of a plant or a tree enables it to carry out its activities. |

| | |
|---|---|
| 5.2.1 **To explain** the importance of the horizontal position of the branches of a fir tree. | Facilitates the absorption of light. |
| 5.2.2 **To explain** the importance of the high position of the leaves of a maple tree. | Facilitates the absorption of light |
| 5.2.3 **To explain** the importance of the particular structure of a dandelion seed. | Light glider: easily dispersed by the wind. |
| 5.2.4 **To explain** the importance of the particular structure of a maple seed. | Heavy glider: not easily dispersed by the wind. |
| 5.2.5 **To explain** the importance of the dull appearance of a maple leaf. | Reduces loss of light by reflection. |
| 5.2.6 **To explain** the importance of the large surface area of a maple leaf. | Good light absorption, . . . |
| 5.2.7 **To explain** the importance of the large number of needles on a fir tree. | Good light reception, . . . |
| 5.2.8 **To explain** the importance of the small surface area of the needle of a fir tree. | Resistance to cold, . . . |
| 5.2.9 **To explain** the importance of the bud scales of a tree. | Protection against cold, . . . |
| 5.2.10 **To explain** the importance of the underground bulb of a given plant (e.g. trillium, tulip). | Resistance to cold, storage of energy reserve, . . . |
| 5.2.11 **To explain** the importance of resin (gum) in the bark of a fir tree. | Resistanc : to cold, helps preve withering, |

**Attitude:** To be willing to take an investigative approach.

**To know how to interpret** the results of an experiment.

**To know how to recognize** whether or not an assumption is confirmed by the results.

T.O. 5.3 **To differentiate** between "basic requirements" and "optimum requirements."

Optimum requirements are related to the level of tolerance to light, temperature, and atmospheric humidity, . . .

5.3.1 **To discover**, by means of an experiment, the response of a plant to variations in light intensity.

5.3.2 **To discover**, by means of an experiment, the response of a plant to variations in temperature.

5.3.3 **To discover**, by means of an experiment, the response of a plant to variations in the amount of water it receives.

5.3.4 **To identify** conditions which, if changed, would modify the optimal development of an organism.

**Attitude:** To be willing to take an investigative approach.

**To know how to relate** a series of observations made over a period of time.

T.O. 5.4 **To identify** the following stages on a diagram of the life cycle of a flowering plant: plant in full leaf, flower, fruit, seed.

5.4.1 **To discover**, by means of an experiment, the changes that occur in the different parts of a flower.

T.O. 5.5 **To identify** the following stages on a diagram of the life cycle of an insect: egg, larva, nymph or pupa, adult.

5.5.1 **To discover**, by means of an experiment, the transformation of an insect from larva to adult (metamorphosis).

**Attitude:** To be willing to follow a structured approach in consulting reference material.

**To know how to find** an explanation of a phenomenon on his own.

**To know how to verify** the truth of his arguments with the aid of reference materials (books, films, . . .).

| | | |
|---|---|---|
| T.O. 5.6 | **To identify** one or more reasons for a particular activity of a given organism. | E.g. the trillium grows before the leaves of a forest appear. Why? |
| 5.6.1 | **To investigate** the reasons for a given construction: beaver lodge, ant nest, beehive, spider web, . . . | Need for shelter, need for food, support for moving from one place to another, means of protection, . . . |
| 5.6.2 | **To investigate** the reasons for the song of a given bird, or the cry of a given animal. | Establishing of territory, identification of individuals, attraction of females, means of defence, use in display, (mating gestures), . . . |
| 5.6.3 | **To investigate** the reasons for the visible markings on a given animal, e.g. speculum of a duck, white tail of a deer, red mark on a seagull's beak. | Identification of the species, use in display, indication of intent, use as alarm signal, . . . |
| 5.6.4 | **To investigate** the reasons for the scent trails and scent markings of a given animal. | Establishing of territory, identification of living space, identification of the species, use as alarm signal, attraction of a mate, . . . |
| 5.6.5 | **To investigate** the reasons for the actions of a prey faced with a predator. | Hiding from the predator, fleeing from the predator, confronting the predator, . . . |
| 5.6.6 | **To investigate** the reasons for the actions of a predator in pursuing his prey. | Moves constantly, conserves its energy during the hunt, attacks weak animals, . . . |
| 5.6.7 | **To investigate** the reasons for the metamorphosis of a given insect. | Mechanism for protection from the elements, taking up a new habitat, |
| 5.6.8 | **To investigate** the reasons for the falling of the leaves of a tree in autumn. | Mechanism for protection from the elements, energy conservation, decrease in exposed surface area, . |
| 5.6.9 | **To investigate** the reasons for the persistence of the needles of fir trees. | Mechanism for protection against the elements, energy conservation, early activity, . . . |

46

| | |
|---|---|
| 5.6.10 **To investigate** the reasons for the flowering of particular given plants in the undergrowth. | Exposure to sun before the leaves form on the trees. |
| 5.6.11 **To investigate** the reasons for the presence of small leaves on the upper part of a tree and large leaves on the lower part. | Adaptation to light. |
| T.O. 5.7 **To identify** the advantages of researching new varieties and strains in agriculture. | Economic importance<br>— increased profits for the producer.<br>— lower prices for the consumer |
| 5.7.1 **To give** a simple definition of the word "variety | Subdivision of a species, limited to variation of certain individual characteristics. |
| 5.7.2 **To identify** techniques employed by researchers to obtain a variety or strain. | Selection of parents, selection of offspring, reproduction. |
| 5.7.3 **To name** qualities sought in individual specimens in working to obtain a variety or new strain. | Resistance to cold, resistance to disease, resistance to parasites. |

**Attitude:** To be willing to re-examine objectively the ways in which he relates to nature.

**To know how to solve** a problem through discussion or dialogue.

**To know how to carry out** a project.

| | |
|---|---|
| T.O. 5.8 **To investigate** the ways in which man can benefit from his relationships with nature. | Improvement of man's living environment to meet his needs, adaptation of man to environmental conditions, appropriate recreational activities. |
| T.O. 5.9 **To investigate** the risks and dangers involved in the ways that man relates to nature. | Alienation, acceptance of ugliness and noise. |

# 7. Evaluation

## 7.1 Definition

Educational evaluation is defined as a "process intended to support appraisals of the situation of a pupil in certain areas of his development, with a view to making the best possible decisions about his future progress."[1]

Evaluation is based on the results obtained from the use of appropriate measurement instruments in order to make as accurate an appraisal as possible, and to make sure that decision making will be fair and equitable for all concerned.

The evaluation approach selected for this course corresponds to the instructional approach and is integrated with the teaching process which it clarifies and supports.

## 7.2 Aims of Educational Evaluation

The basic aim of educational evaluation is "to improve decisions about a pupil's learning and general development."[2]

The teacher has the main responsibility for evaluation because he is the person who is in the best position to assess the level of attainment of a learning objective. An assessment based on appropriate instruments of measurement will provide the pupil with the information he will need. The teacher, in assessing the effectiveness of his teaching, will be able to identify the strengths and weaknesses of his pupils and, on the basis of this information, make informed decisions with regard to their progress. This is the main purpose of evaluation.

A second aim of educational evaluation is "to furnish parents with information about their children's progress in reaching their educational objectives."[3]

## 7.3 Evaluation Procedure

With a view to providing the best possible measurement and evaluation, a suggested procedure for the Ecology course is offered here as a support for the teacher in preparing his evaluation.

The procedure comprises four phases and each of these is based on a question:

Phase 1: Why evaluate?
Phase 2: What should be measured?
Phase 3: How should a measurement instrument be prepared?
Phase 4: How should the measurement be interpreted?

### Phase 1

For the purposes of evaluation, the teacher must first identify the need(s) to be met. For example, is the reason for the evaluation to ascertain the extent to which learning objectives have been attained? Is it to make a general assessment of the progress of a group? Is it to diagnose the strengths and weaknesses of the learning situation? Is it to discover the causes of particular learning difficulties?

### Phase 2

The measurement instruments should be designed to take into consideration not only the content on which the objectives are based, but also the attitudes and skills which are included in the course.

A table of specifications for this purpose will serve as a guide for preparing measurement instruments and a rating scale. This table shows the content of the questions and gives the relative importance of the related content, given the amount of time spent on these, and also takes into account the types of intellectual skill the teacher is assessing (taxonomy).

### Phase 3

Preparation of items is an important task for the teacher. In order to avoid ambiguity and unfairness, the items should correspond to the objectives to be measured. In other words, the verb used to describe the behaviour, content, and context on which the item is based, should be closely related to the circumstances under which the subject is taught.

In addition, the items should be clearly expressed and formulated to suit the level of the pupils' abilities.

Various types of measurement instruments may be used to collect information: examinations,

1. Québec, ministère de l'Éducation, Direction générale du développement pédagogique, Direction de l'évaluation pédagogique. *General Policy for Educational Evaluation*. Québec, 1981, p. 7.
2. *General Policy for Educational Evaluation*. Op. cit., p. 6.
3. *General Policy for Educational Evaluation*. Op. cit., p. 6.

tests, rating scales, observation and evaluation forms. The observation and evaluation forms have certain interesting advantages as they serve to collect information concerning the development of certain attitudes. They also provide an educational support for pupils with regard to their learning progress and, at the same time, serve to monitor the quality of teaching activities.

**Phase 4**

After the information is obtained through measurement, the results must be interpreted so that a value judgement may be made. Norm-referenced or criterion-referenced interpretation may be used.

Traditionally, norm-referenced interpretation of measurement has had an important place in the educational activities of the school. However, today it is felt that criterion-referenced interpretation of measurement should be favoured because, from an instructional point of view, it is certainly more relevant to know the pupil's level of mastery of an objective without reference to the levels of other pupils than to be informed of a score which assesses the pupil's achievements in relation to those of other pupils. Criterion-referenced interpretation provides a continual reinforcement of learning and makes it possible to identify problems as they occur and to correct them. It enables teachers to choose more appropriate teaching strategies and learning activities to suit the pupils' level of progress. This process is called formative evaluation.

Summative evaluation, on the other hand, is intended to inform the pupil and teacher of the extent to which a group of terminal objectives has been attained. It provides a sort of evaluation balance sheet and may be used at the end of teaching and learning sequences of varying duration. Only the results of summative evaluation may be reported and sent to parents.

To sum up, the scores that the 12 and 13 year old pupil receives for his performance are an important motivating factor for him. The teacher should make frequent assessments to meet this need if he wishes to maintain a good learning climate and to obtain a sustained level of pupil performance.