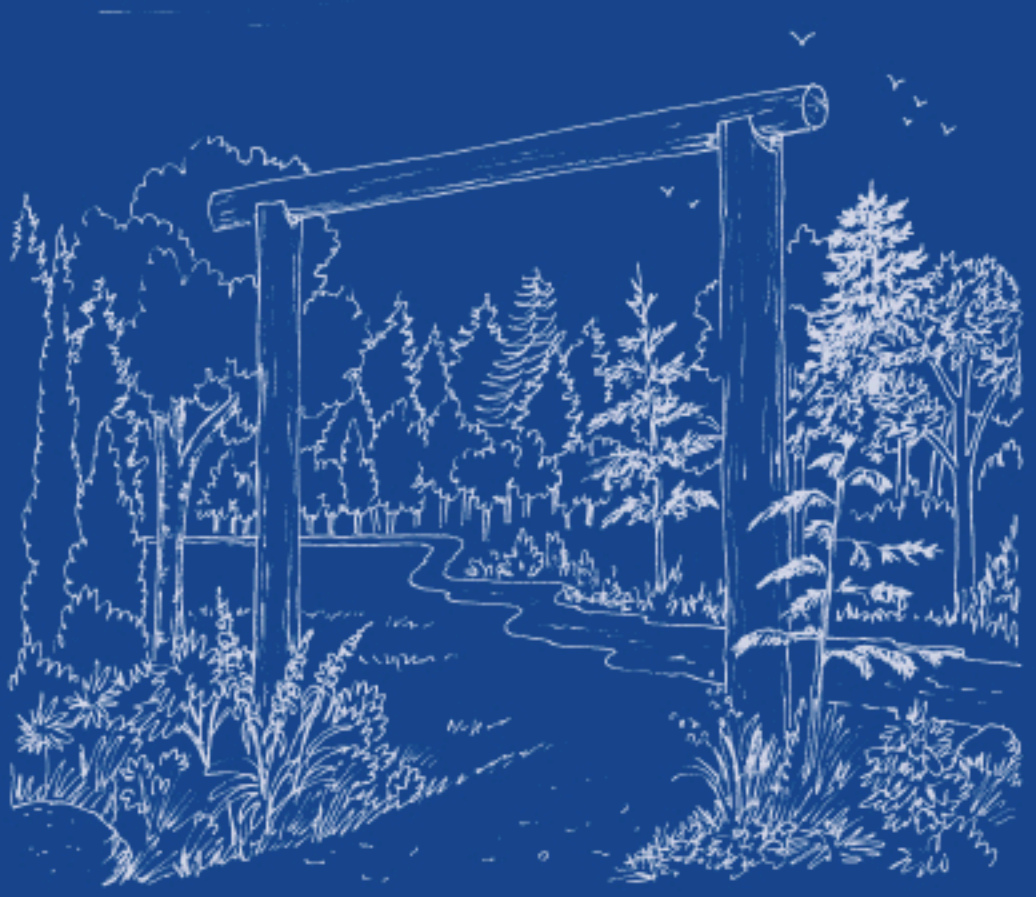
PARKS AND PROTECTED AREAS

The Nature of Science: Kananaskis Edition



Alberta
COMMUNITY DEVELOPMENT

Kananaskis Country

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if you haven't got a tolerable planet
to put it in on?"
Henry David Thoreau

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"Adopt the pace of nature.
Her secret is patience."

Ralph Waldo Emerson

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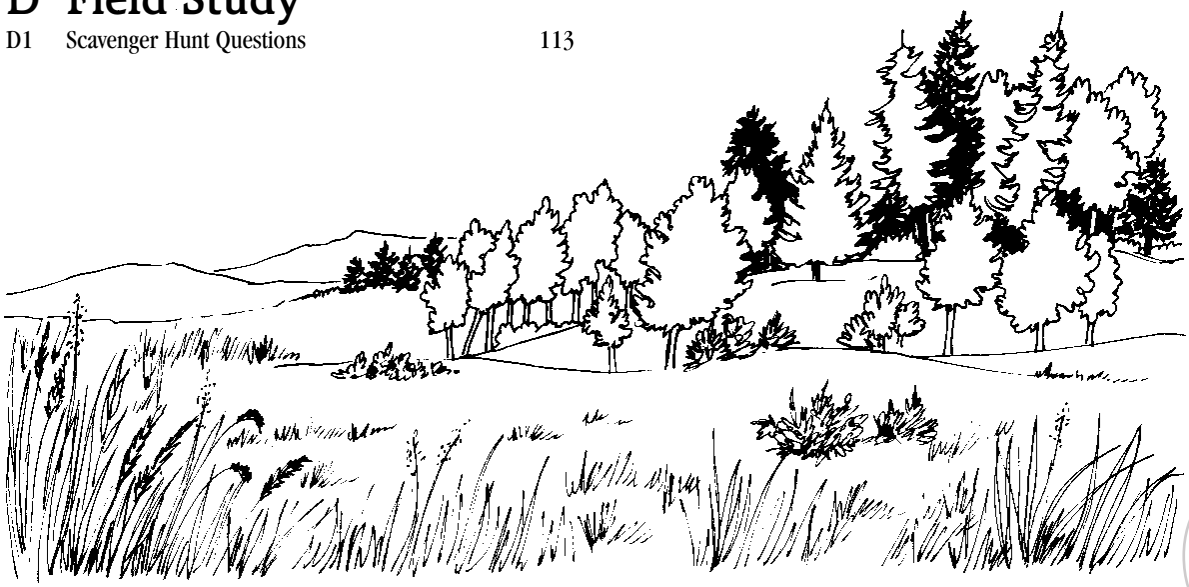

"The truth is that human beings are now the dominant species in all the world's ecosystems and the most powerful geological force on earth. From this perspective, we don't have environmental problems, the biosphere has a people problem."

Mathis Wackernagel and William Rees, Authors of Our Ecological Footprint

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Notes…

The "Nature" of Science

1.0 Introduction

Notes…

1.0 Introduction

Welcome to **The Nature of Science**, a teacher-conducted science program for grade eight students.

This is a curriculum connected full day field study with multidisciplinary preparatory and post activity support. The intent is to offer a natural experience for students that reflects the outdoor field study components of theme 6: Interactions and Environments from Grade 8 Alberta Science Curriculum and the goals of Alberta Community Development, *"As proud stewards of Alberta's renewable natural resources, we will protect, enhance and ensure the wise use of our environment."*

Within Alberta Community Development, Parks and Protected Areas, one of this department's objectives is to *"Develop environmental education programs and materials that educate about preservation, heritage appreciation, outdoor recreation and tourism, in the context of Alberta's recreation and protection areas with a emphasis on the natural heritage sites."*

This program has been developed through the leadership of the Fish Creek Environmental Learning Centre in Fish Creek Provincial Park. The **"Nature of Science"** program has been designed to be conducted within any natural area in Alberta. Three different versions of this teacher-directed program (Appendix A) have been developed in Fish Creek Provincial Park, at designated sites in Kananaskis Country and across Alberta.

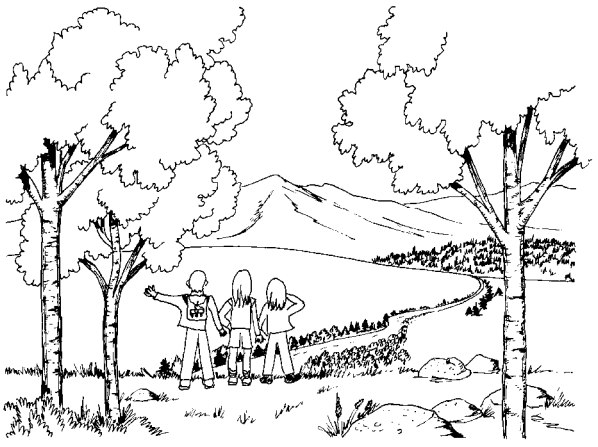
For more information on this and other Kananaskis Country Programs and services, contact:
Environmantal Education Coordinator
Kananaskis Country
Suite 201, 800 Railway Avenue,
Canmore, Alberta T1W 1P1
Phone: 403-678-5508
Fax: 403-678-5505
www.cd.gov.ab.ca/envparks/kananaskis/

1.1 At A Glance

Program

Topic	Grade 8 Science Theme 6: Interactions and Environments
Time Required	preparatory field study activities: 8-10 hours field study: full day post field study activities: 5-6 hours
Adult Requirements	1 instructor (teacher) 1 volunteer for each group of 6 students
Best Season	spring through to early fall
Suggested Location	Kananaskis Country • Bow Valley Provincial Park • Bow Valley Wildland Provincial Park • Peter Lougheed Provincial Park

Students will be presented with a scenario and challenged to develop a plan that will protect all of the ecosystems they visit during a field study by developing a list of activities or 'uses' that would be permitted in each ecosystem according to the level of protection they determine each ecosystem requires.



Students will explore 2 or 3 different ecosystems (or communities) in an effort to define and describe them, while gaining an understanding of the interdependence, interactions, specialized life forms and adaptations that sustains the plants and animals that live there.

Students will develop a list of criteria for determining the level of protection any area should have. This will then be compared to an accepted list of protected areas criteria. After merging these two criteria lists, students will use their protected areas criteria lists to determine the level and type of protection required to sustain the relative health of the ecosystems they visit during the field study.

Protected area data on areas such as the Wind Valley and the Bow Valley Corridor will be available to provide an authentic basis for comparison.

Students will also identify the human behaviors that present challenges to the sustainability of ecosystems, and will explore the behaviors they can adopt to reduce the stress they personally place on the environment.

While working in groups or individually, students will complete projects and activities that reflect the processes and learning associated with this experience. Many of the finished products from these projects and activities can be shared with other schools.

1.2 Program Rationale and Approach

Rationale

The "Nature" of Science poses an overall scenario, along with classroom and field study activities designed to explore this scenario. The notion of environmental literacy (Appendix B1) is integrated throughout the study to develop the students' capacity to perceive and interpret the relative health of environmental systems, and to take appropriate actions to maintain, restore, or improve the health of those systems (Appendix B2).

The true value and educational impact of curriculum connected field studies, such as this one, is in the sequence of experiences created through preparatory activities at school, followed by a field study, and then concluded with post activities and summary reports back at school.

The preparatory activities, focusing on knowledge and skills development, are intended to prepare students to make the most of the field study experience. After introducing the field study, students select a special project that they will use to summarize and reflect their learning throughout the field study experience. The remainder of the preparatory activities focus on defining ecosystems, monitoring the environment, exploring land use within protected areas, discussing human behaviors that challenge environmental quality while providing an orientation to field study methodologies, issues analysis and data collection.

The field study is an authentic experiential adventure that explores the natural world and provides an immersion experience in a place that is increasingly NOT part of their day to day lives. Only four to six percent of our time is now spent in outdoor settings, the rest is within created structures. This field study program follows accepted scientific practices and procedures while modeling what scientists actually do in the field.

The morning begins with an active scavenger hunt. This is followed by a guided exploration of a single ecosystem or community. After a discussion at lunch that focuses on the events of the morning, the afternoon program begins. Throughout the afternoon students explore two more ecosystems, participate in another active outdoor game and have time to reflect in a student journal that guides the activities of the day.

The post activities provide an opportunity to consolidate student learning, celebrate their success and apply what they have learned in their own communities. The completion of a special project they select during the preparatory activities facilitates the post activities.

Throughout this program an effort has been made to integrate other curriculum areas when possible. For example, social studies is woven in through the use of issues, language arts is incorporated through activities such as debates and student reflection journals and technology are used to measure, collate and interpret data. It is important for students to recognize that science doesn't always provide all the answers to environmental challenges. Instead, students are encouraged to explore a wide range of topics, issues and disciplines before adopting any changes in behavior and action.

Approach

Science and environmental educators have long involved their students in field studies that gather and interpret data about the natural world. This, in many ways, is the true "nature" of science. When students venture into the field to gather data and monitor the natural world they should have a very clear understanding of a few basic realities:

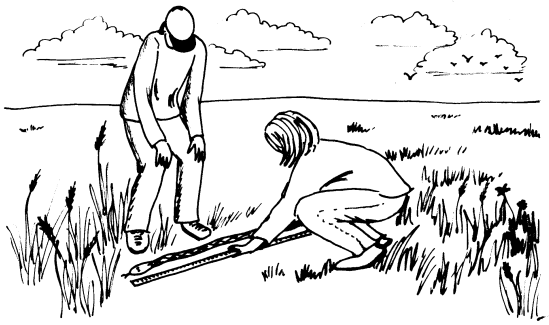
- Data collection in itself is not the end point. It provides the vehicle to answer questions and explore issues.
- Student involvement in the designing of the field study increases the learning associated with the experience.
- Students should have a clear understanding of why the data is being collected and how it will be used.
- Data collection and environmental monitoring implies follow up action.

"A leader is best when people barely know he exists, not so good when people obey and acclaim him, worse when they despise him. Fail to honour people, they fail to honour you. But of a good leader, who talks little, when his work is done, his aim fulfilled, the people will say, "We did this ourselves."

Lau-Tzu

As students collect data on the ecosystems they explore they will be progressively building an understanding of each ecosystem as unique from any other. They will be challenged to develop a plan that will protect, to some extent, each of the ecosystems they visit. The data they collect will be used to define and understand ecosystems, identify issues and provide support for the recommendations in their protection plans.

Students will be involved in the design of the field study on a number of fronts. While the overall structure of the day is already established, how they complete tasks within this structure is very open. Students will choose the project format they wish to use to convey their data, understanding and plans for protection. They will be involved in activities that select issues to focus on. They will define the criteria for determining the type and level of protection an ecosystem should receive. This will empower them to get involved in a manner that personally interests them.



A primary focus of the preparatory activities is to provide students with an understanding of why the data is being collected and what they will be expected to do with this information. Through the collection of data, students will gain an understanding of how ecosystems work while beginning to recognize the challenges many ecosystems face due to the impact of humans.

They will use this understanding to develop a project that will demonstrate their understanding of ecosystems and environments, how ecological integrity can be sustained through the development of a variety of protected areas that limit human use, and what they can do as individuals to reduce the pressures humans place on ecosystems and environments. Many projects also include an education component that provides an opportunity to share their data, interpretations and protected areas recommendations with others schools involved in similar ventures.

Data collection and interpretation experiences lead to a greater understanding, appreciation and respect for the natural world. It often results in connections that foster a desire to do something to enhance the environments they depend on. Through the integration of environmental literacy (Appendix B) components, student projects and specific follow up activities, students are encouraged to adopt personal behaviors that reflect a greater understanding of ecological systems and the relative health of ecosystems and environments.

You and your students are encouraged to forward class projects to the Minister of Alberta Environment, local Members of the Legislature Assembly (MLA), municipal governments and environmental groups. The more information is shared, the more informed we all become.

Copies of student projects can also be sent to the Fish Creek Environmental Learning Centre, or the Kananaskis Country Environmental Education Department.

1.2.1 Student Projects

There are two alternatives for providing a structure that students could use to express and demonstrate their learning (see section 2.3 for details). The best choice for facilitating the field study and incorporating the notion of environmental literacy is for groups of students to complete one of the projects outlined in detail in Section 5.2.

Student Group Activities

As an early preparatory activity students should form groups and select the project format they will complete to summarize their learning on this field study. The type of project they select must be a consideration in how they conduct the entire field study experience. Each project is unique in some fashion. Students must be aware of the specific expectations of their project and ensure they gather data and explore issues in a manner that will enable them to complete their final project.

If you are choosing to organize your students into small groups, the following is a list of possible projects to consider. See Section 5.2 for more details.

5.2.1 complete individual or group lab report project
5.2.2 powerpoint computer presentation
5.2.3 slide / tape presentation
5.2.4 video presentation
5.2.5 dramatic presentation
5.2.6 community in a creative container
5.2.7 ecosystem puzzles
5.2.8 large interactive 3-d puzzles
5.2.9 public education program
5.2.10 3 dimensional book
5.2.11 urban planning and the role of protected areas
5.2.12 website
5.2.13 environmental magazine
5.2.14 access in a protected area

Post Activities For The Entire Class

If class dynamics or available time present a challenge, and you are choosing to NOT do small group projects, the alternative is to complete the follow up activities described in section 5.3, as an entire class. First, consider the projects that are outlined in the package (section 5.2). Many of them lend themselves to class room follow-up work as activities or in-class lessons. Beyond that the following describes some other full class activities.

5.3.1 individual lab report
5.3.2 unknown species
5.3.3 protected areas debate
5.3.4 local stewardship of a 'protected area'

1.3 Program Objectives and Curriculum Fit

"For the first time in my life
I saw the horizon as a curved line.
It was accentuated by a thin seam of dark blue light – our atmosphere.
Obviously this was not the ocean of air I had been told it was so many times in my life. I was terrified by its fragile appearance."

Ulf Merbold, Astronaut for the Federal Republic of Germany

This field study engages students in the scientific study of living things in relationship to their environment. The program has been designed to meet the curriculum requirements of the Grade 8, theme 6: Interactions and Environments from the Alberta Program of Studies. It has also been designed to reflect the knowledge concepts identified in the Specific Learner Outcomes in the Pan-Canadian Protocol for grade 7 and 8.

Objectives:

After completing the three components of the program (preparatory, field study and post activities) students shall:

1. Be able to define / describe an ecosystem.
2. Be able to analyze an unknown ecosystem to gain a better understanding of it.
3. Improve environmental literacy and ability to recognize and appreciate the effects of human action (positive and negative) on ecosystems.
4. Be involved in a variety of activities that integrate other relevant curriculum areas.
5. Be prepared to take personal action based on what they learn.
6. Develop a connection to the natural world through involvement in a quality experience.

Curriculum tie-ins:

This field study meets the following components of the Alberta Science Curriculum.

Attitudes

Students will be encouraged to develop:

1. Awareness of the complex interrelationships among living things and their environments.
2. Awareness of the nature and extent of impacts on environments caused by human actions.
3. Concern and commitment for the maintenance of life-supporting environments.

Skills

1. Questioning
   - recognizing patterns and discrepant events
2. Proposing Ideas
   - hypothesizing relationships among specific living things
   - hypothesizing relationships between living things and abiotic conditions of their environments.

3. Gathering Data
   - observing living things in their environments
   - observing the distribution of living things in environments
   - measuring

4. Processing Data
   - classifying living things within a study plot
   - organizing and presenting data

5. Interpreting Data
   - inferring evidence of relationships among living things
   - inferring the effects of environmental conditions on the distribution of living things in an environment.
   - developing theoretical explanations

Concepts

1. Environments can be described in terms of abiotic conditions:
   - identify, observe and measure abiotic factors in environments
   - classify and describe an environment in terms of the abiotic factors that characterize it

2. The interdependence of living things is evident in the interactions of organisms with each other and with their environments:
   - interpret distribution of living things within their environments
   - classify animals within the ecosystem as producers, consumers and decomposers

3. Within environments, specialized forms of life can be found. The environmental needs of these living things can be inferred from their distribution and from their life habits:
   - identify and describe habitats and microhabitats
   - identify niches within an environment
   - identify examples of variations in the light, soil and temperature needs of organisms
   - predict the effects of minor changes in characteristics of an animals or plant in its ability to survive in a given environment.
   - predict the effect of changes in environmental conditions on the ability of particular plants and animals to survive in that environment.

4. Environmental interventions can be found to have both intended and unintended consequences:
   - identify intended purposes and consequences (positive and negative) of human activities in local environments
   - predict consequences of selective addition or removal of living things from an environment

1.4 Cross Curricular Connections

It is always easier to justify a full-day field experience if direct connections to other curriculum areas are incorporated into the field study sequence of activities. Built in to this field study are many natural connections within other units of the grade 8 Science curriculum and with other Programs of Studies. With team planning and the cooperation between various teachers, students can be involved in a multi-disciplinary adventure which allows for diversity in learning and teaching styles and which touches many curriculum areas.

Other Science Units and Themes

Several of the activities during the actual field study day draw on knowledge that the students have obtained in other units in Science. Students should have a good understanding of pH as it relates to solutions by the time they complete the unit "Solutions and Substances". This will help them as they attempt to determine the acidity of the soil in their study areas. Their understanding of soil types and their porosity from "Growing Plants" with help the students better understand the soil type in their study area as well.

Probably most evident are the cross-curricular connections with the Social Studies and Mathematics Programs of Study. Many connections can also be made with the Language Arts and Technology curricula.

Social Studies

One topic in Grade 8 Socials requires an in-depth study of Brazil. If this unit coincides or precedes the field study, students are able to make many connections bringing their learning form their studies of Brazil much closer to home. For example, after looking at the complex interactions present in the Brazilian rainforests and the economic and environmental consequences of human impacts of that ecosystem, students are motivated to not allow the same consequences in their local environment. Trade-offs in Brazil can be compared on a lesser scale to trade-offs that we might have to make in the development of a management plan for the ecosystems studied during the field study.

Through the Parks and Protected Areas Program, Alberta has charted a course to set aside areas representative of the six natural regions and 20 sub-regions that exist in Alberta. The result will be a network of protected areas that represent the province's environmental diversity. These protected areas are divided up into 6 categories according to their heritage and recreational value. These categories include: Wildlands (57%), Provincial Parks (14%), Wilderness Areas (10%), Natural Areas (8%), Recreation Areas (8%) and Ecological Reserves (3%).

Language Arts

The preparatory and post-visit activities and projects employ the use of many Language Arts skills. Students have the opportunity to share their knowledge through the use of written and oral reports. The study of issues provides a perfect opportunity for the use of debates.

Mathematics

In Mathematics, teachers are often looking for authentic experiences to practice basic algorithms in a motivating environment. A field study like this responds to the frequent question from teenagers, "When are we ever going to use this stuff?" this field study allows students to collect data for analysis and comparison. Students are required to make observations and to use the observations to make conclusions - key skills in both the Mathematics and Science curricula. Students are required to do exact measurements and are also required to use the skills of estimation and visualization. A key concepts that is required in the measurement components of this field study is the use of ratios, rates and percents to determine populations of plants in the study area for comparison at a later date. These activities also touch on the use of probability theories for population counts and the differences between a sample and a population.

Technology

This study also has the potential to meet several of the outcomes presented in the upcoming technology curriculum. Students can use databases and spreadsheet programs to organize and display data. Schools with the appropriate technology could have their students present their finding using powerpoint or students could design a website to share their findings. Connections could be made with another school in another part of Alberta to share findings and make comparisons.

Role of Technology during the field study

Technology will be used to enhance the learning and experiences in this program. It will not be used in the field study itself. Rather, technology will be incorporated into preparatory and post activities as a vehicle to integrate, interpret and enhance learning.

1.5 Scenario and Guiding Questions

You, as a member of a five person science team, have been contracted to make recommendations about how to protect three ecosystems, you will visit during a field study, from potential environmental damage while still allowing them to be "used" by humans.

Alberta has a variety of protection levels within its protected areas legislation (Appendix A2). The level of protection varies according to a wide variety of criteria. The extent or degree of protection is represented in the measure and type of land use permitted from one protected area to another. Throughout this field study experience, students will explore three different ecosystems. According to the criteria students develop for determining the level of protection an area should receive, and what they discover about each of the ecosystems they visit, they will be asked to make recommendations, as a scientific team, about what types and levels of land use should be permitted in each ecosystem they visit, in order to maintain the long term health of each ecosystem.

To explore this scenario the following guiding questions will be used through preparatory activities, field study exploration and post activities in an effort to help students clarify the issues and formulate an informed and articulate response to the problem.

1. What defines an ecosystem?
   - Students will be able to define and describe a variety of ecosystems.
   - Student will be able to analyze an unknown ecosystem to gain a better understanding of it.

2. What factors influence and interact to create different ecosystems?

3. What is a protected area?
   - What criteria should be used to decide on the level of protection an area should receive?
   - What uses should occur in these ecosystems?
   - To what level should these uses be permitted to threaten the protected area?
   - What impact do these uses have on the long term health of the ecosystem?
   - How do you balance the needs of wild plants and animals with the needs of humans when they threaten an area?
4. How does natural diversity influence how an area should be protected?
5. How does population influence how an area be protected?
6. How do aesthetic features influence how an area should be protected?
7. What human activities or land uses threaten the sustainability of ecosystems?
8. What actions could be undertaken by individuals, governments and business to ensure that laws about protected areas are followed?

"Never doubt that a small group of thoughtful committed citizens can change the world. Indeed, it's the only thing that ever has."

Margaret Mead

1.6 Activity Descriptions

This is a comprehensive program that contains preparatory activities, a field study and follow up activities that are specifically designed to support each other. This is a brief description of the activities involved in each facet of the program.

1.6.1 Preparatory Activities

1.2.1 Student Projects

These are used to provide a structure for students learning throughout the preparatory activities, field study and post activities.

1.5 Scenario and Guiding Questions

The entire program centres around a scenario that students explore.

2.1 Program Introduction

Slides are used to introduce ecosystems and the notion of protected areas.

2.2 Student Reflection Journals

Journals are used as a tool for students to record observations, thoughts and information throughout the program.

2.3 Scientific Teams

This is a description of the scientific team roles that students take to complete this program.

2.4 Follow up Full Class Activities and Groups Projects

This is a description of the various formats students use to summarize and describe their learning throughout the program.

2.5 Who Am I? (part 1) The Legend of The Valley

Students are introduced to the concept of change through a legend story.

2.6 Introduction To The Field Study Methodology

This is a series of activities that are designed to familiarize students with the field study data gathering methods.

2.7 Describing An Ecosystem

This activity lead students through a process that results in a series of questions they would ask to effectively describe an ecosystem.

2.8 What is a Protected Area?

This is a series of activities that explore the notion of protected areas and how this concept is incorporated into the field study program.

2.9 Vocabulary

This is a glossary of operational definitions for the terms used in this program.

2.10 Class Discussion About the Field Study

This is a checklist to guide a class discussion that focuses on specific field study concerns.

1.6.2 Field Study Activities

4.1.1 Program Orientation

Students receive a 15 - 20 minute orientation to the Park and the program upon arrival.

4.1.2 Scavenger Hunt and Questions

This is a non-site specific activity that introduces students to a variety of ecosystems as they search for the answers to some creative questions.

4.1.3 Ecosystem Explorations

4.1.4 Grasslands Ecosystem Exploration

This is a teacher-led exploration of a grassland ecosystem that models the approach students will use, on their own, to explore 1 or 2 other ecosystems during the field study.

4.1.5 Summary Discussion and Student Reflection Journal Entry

After the morning activities are complete this activity poses a series of questions and issues that guide a class discussion and subsequent journal entry.

4.3.1 Detailed Exploration of One or Two Other Ecosystems

Students explore two additional ecosystems according to what they learned in the morning.

4.3.2 Protected Areas Role-Play Active Game

This active game challenges students to develop a protected area that will allow all who live and visit there to co-exist in a healthy manner without damaging the natural world. Students then "move" through the protected area they developed to see if they can survive as a natural species.

4.3.3 Summary Discussion and Student Reflection Journal Entry

To complete the afternoons activities the students complete a journal entry.

1.6.3 Post Activities

5.1 Connecting Ecosystems

This activity provides an opportunity for all students to share their data and observations from the field study so that everyone can build on the databank of information they will use throughout the post activities.

5.2 Student Group Activities

This section describes the suggested methods students, working in small groups, could use to summarize their learning during this program.

5.3 Full Class Post Field Study Activities

This describes a series of activities that are teacher-led and directed at the entire class.

5.3.2 Unknown Species

This activity presents students will information about a variety of species. They are challenged to use the data they gathered on the field study to determine what the species is and which ecosystem they would live in.

5.3.3 Protected Areas Debate

This activity suggests issues and topics that student scientific teams could debate in an all class forum.

5.3.4 Local Stewardship of a Protected Area

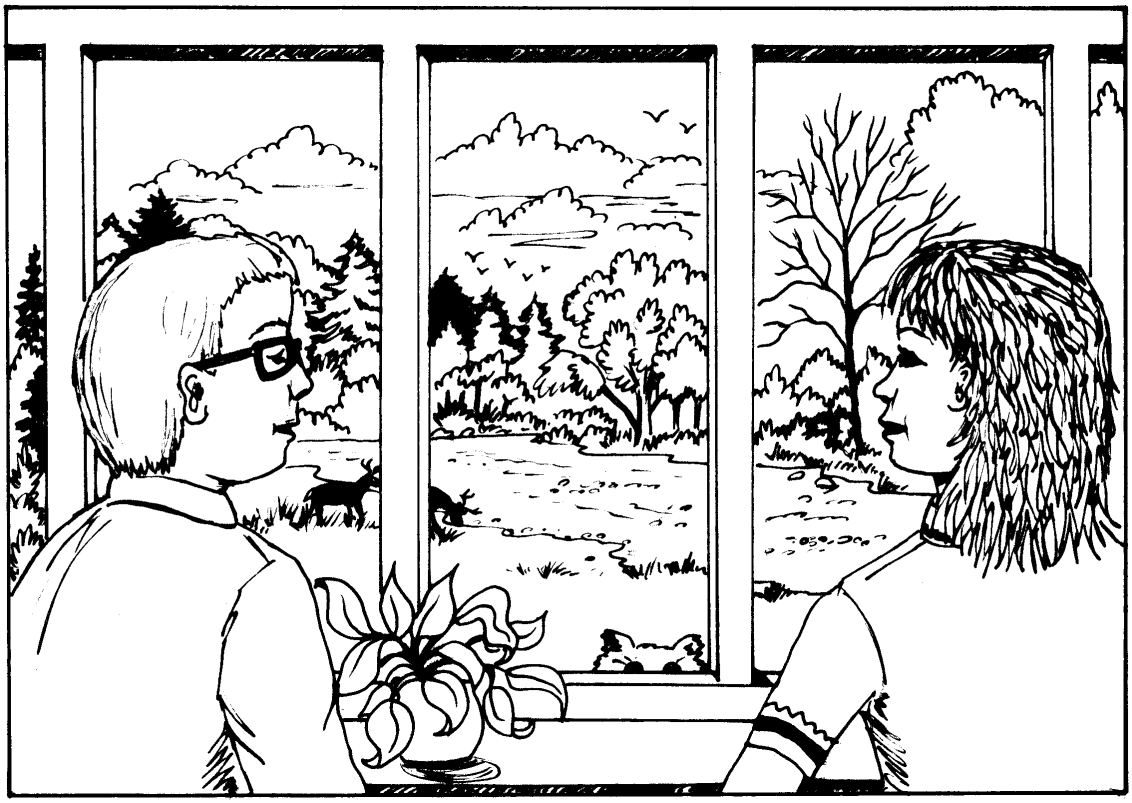
Students select a local "natural area" and make efforts to protect it.

6.1 Who Am I (part 2) Destiny of a Valley

Students reflect back on the original legend and write a guided journal entry about how the plans they have developed will lead to the ecological sustainability of the ecosystems they explored.

7.2 Post Test

This is a post test that has been developed to evaluate the learning associated with this program.



The "Nature" of Science

2.0 Preparatory Activities

2.0 Preparatory Activities

2.1 Program Introduction

Objective:

Initial introduction of the field study project to students.

Time Required:

20 - 30 minutes

Teacher Instructions:

1. Select a recent local news item that discusses an environmental issue. Introduce this to the students.
2. Select six slides, or use the ones provided (Appendix C1), that represent images of areas that your students are familiar with. These could include a local playing field, shopping mall, green space, before and after pictures of a developing area, historical pictures and modern day pictures of the same location, provincial park, protected area or residential backyard for example.
3. Show the first slide and ask the students some questions about the slide. Discuss the thoughts that come forward.

- Is this a protected area?
- Is this area worth protecting? why or why not?
- What types of protection do you see in the image?
- What would happen to this area if there was no type of protection for it?
- What land uses (natural and human) do you see in the image?
- What plants and animals do you see in the image?
- What ecosystems do you see represented in the image?
- What evidence of human activity do you see? Do these represent good or bad influences?
- What would you do to sustain or improve the existing environmental quality of the area in the slide?

4. Show the second slide and continue the conversation. The last slide you show should be an image of the natural area being visited on the field study.
5. Summarize the activity with a discussion about decision making. Decisions are made based on the best available information from all sources and viewpoints at the time of the decision. When new information becomes available it can mean re visiting, and perhaps changing,an old decision. This is the nature of science. Science does not provide all the answers to environmental issues. It offers a perspective that must be considered along with many others. Science involves applying what you know, to what you do not know, to learn something new. This field study will introduce many ecosystems, environments, issues, environmental concerns and challenges that have many solutions. The challenge is to gather and consider all the data before a decision is made and not to be afraid to change that decision when new information becomes available.

"The world grows more crowded year by year and at an ever increasing rate. Men push farther and farther in their search of 'resources' to be exploited, or for more space to occupy. Increasingly they tend to think of the terrestrial globe as their earth. They never doubt their right to deal with it as they think fit - and what they think fit usually involves the destruction of what nature has thought fit to build during many millions of generations."

Joseph Wood Krutch

2.2 Student Reflection Journals

Objective:

To provide a tool to record data, observations, thoughts and anecdotal comments.

Time Required:

15 - 20 minutes

Teacher Instructions:

The Student Reflection Journal is a tool for students to use throughout the program to record observations, diagrams, ideas, data and questions, while providing a forum for them to comment on how they feel their field study experience is progressing.

Instruct each student to provide a pocket size journal with a hard cover. Be sure each journal is in a plastic resealable bag, to protect it from the weather, along with a lead pencil and coloured pencils.The first entry can be a summary of the discussion that occurred during the program introduction slide show. It could include reflection on:

- What is a protected area?
- What things should be considered when deciding if an area should be protected or not?
- Describe an area you think is worth protecting and explain why.
- What types of protection do you see in the slides?
- What land uses (natural and human) do you see in the slides?
- What ecosystems do you see represented in the slides?
- What evidence of human activity do you see? Do these represent good or bad influences?
- Is the protection of natural areas important to you? Explain why or why not.

2.3 Scientific Teams

Objective:

To familiarize students with the group structures and roles used in the field study.

Time Required:

20 - 30 minutes

Teacher Instructions:

Use overheads and props to introduce and discuss the following. Using a "toolkit" filled with equipment and information, small groups will explore an ecosystem and collect data and evidence that is sufficient to describe and define that ecosystem. This field study program models activities used by practicing scientists in the field, when they collect data and monitor the environment. The activities in this section are designed to prepare the students for the types of scientific methodologies they will use, to introduce them to the sorts of data they will be collecting and to review the skills that will be required of them during the field study.

Scientific Teams:

First, inform the students they will be working in scientific teams comprised of 5 people (Appendix C2), each with a different role. Divide the students up into groups and designate roles for each person in the group. Remind them that they may have different roles during the actual field study.

Scientific Team Roles

curator, prepares and labels artifacts gathered, keeps track of equipment

photographer, takes pictures, video and record interviews of the day's events

researcher, organizes the collection of data into charts and graphs

zoologist, collects and records qualitative and quantitative data on animal species

botanist, collects and records qualitative and quantitative data on plant species

all students are expected to enter data on the ecosystem cards

"What you think of yourself is much more important than what others think of you."

Seneca

Explain that on the field study each group will receive a "toolkit" filled with a variety of equipment, tools and materials necessary to gather data on the ecosystems they will visit.

Each group's "toolkit" contains:

- the equipment required to conduct the tests and gather data,
- information sources such as field guide and prepared information sheets specific to that ecosystem,
- maps,
- any "home-made" monitoring devices constructed at school,
- information developed in class as a result of the preparatory activities.

Briefly explain that they will be completing an "Ecosystem Card" (Appendix C3) for each of the ecosystems they visit. In order to do this, they will be required to observe ecosystems, monitor events and complete a variety of scientific tests. A detailed orientation of the Ecosystem Card occurs later in activity 2.6.1.

2.4 Follow Up Full Class Activities and Group Projects

Objective:

To familiarize students with the "all class activities" and "group projects" used to summarize the experience.

Time Required:

20 - 30 minutes

Teacher Instructions:

1. Decide if you wish to conduct full class follow up activities or ask the students to complete independent group projects.
2. Then orient the class to the format being used. It's important to decide this at this point in the process so that if students are completing small group projects they will become aware of what they need to be gathering to complete their assignments.

2.4.1 Full Class Activities

These activities are teacher directed activities that are completed as an entire class. If you are choosing this route, select the activities to be completed, from the list below, and prepare for them. They are described in detail in section 5.3. Individual group projects would not be completed in this case.

Individual Lab Report Project
Each student completes a lab report that summarizes their learning throughout the experience.

Unknown Species
The class must use what they learned throughout this experience to identify some "unknown species" and decide which ecosystem they could live in.

"The peaks were the recognition that it is a harmonious, purposeful, creating universe. The valleys came in recognizing that humanity wasn't behaving in accordance with that knowledge."
Edgar Mitchell

Protected Areas Debate
The class is presenter with, or selects, some environmental issues that are reflected in the field study experience. They must prepare to debate these issue in their scientific teams.

Local Stewardship of a "Protected Area"
The class selects a local "natural area" and makes efforts to protect it.

2.4.2 Individual Group Projects

If you choose to complete individual group projects, introduce each of the following possibilities to your students. Ask each scientific team to select one of the projects described below at the start of the preparatory activities. Each group should submit a 1 paragraph rationale stating why they have made the choice they did. Explain that they must be aware of the goals of their group project throughout the preparatory and field study activities and ensure they are gathering information to complete their project. These individual group activities are described in detail in section 5.2.

Keep in mind that the full class activities represent some excellent teacher directed lessons to assist in completing the group projects.

Group Lab Report Project

The group completes a lab report that summarizes their learning throughout the experience.

"I think", said Christopher Robin, "that we ought to eat all our provisions now, so we don't have so much to carry."

A.A. Milne

Powerpoint Computer Presentation

The group places their report on a powerpoint computer program for presentation.

Slide / Tape Presentation

The group takes slides and conducts interviews during the experience. They use these to create a slide / tape presentation of their report.

Video Presentation

The group records video footage and conducts interviews during the experience. This is edited into a video presentation of their report.

Dramatic Presentation

The group scripts out a dramatic presentation that summarizes their learning on this field study.

Community in a Creative Container

The group develops a "creative container", or series of them, which could be anything they wish. The containers hold artifacts that reflect what they learned through this experience.

Ecosystem Puzzle
The group creates a flat 2 sided puzzle that contains a summary of what they learned throughout this field study experience.

Large Interactive 3-D Puzzle
The group creates a large 3 dimensional puzzle that contains a summary of what they learned throughout this field study experience.

Public Education Program
The group develops a public education program (brochure, info-mercial, poster series, etc) that contains a summary of what they learned throughout this field study experience.

3-Dimensional Interactive Book
The group creates a large interactive book, complete with flaps, tabs, wheels, windows, shapes, etc., that contains a summary of what they learned throughout this field study experience.

Urban Planning and The Role of Protected Areas
The group completes a report that summarizes what they have learned through this experience while making recommendations to the local municipal government about what things should be considered in their long range planning to ensure the health of local ecosystems.

Website Development and Maintenance
The group develop a website, or makes contributions to an existing website that contains a summary of what they learned throughout this field study experience.

Environmental Magazine
The group publishes a magazine that contains a summary of what they learned throughout this field study experience and includes information from other groups in their class.

Access In A Protected Area
The group creates a 3 dimensional model of a protected area that effectively illustrates what they learned on the field study while educating about how people and the natural world can co-exist without causing harm to the environment.

2.5 WHO AM I? The Legend of a Valley: Fish Creek

Objective:

To introduce the concepts of change, history and that the health of ecosystems is regularly challenged by a variety of forces.

Time Required:

30 - 40 minutes

Teacher Instructions:

Read the following story, **Legend of a Valley: Fish Creek,** to your students. Discuss the Legend with a partner. Consider the following questions:

1. What are the names of ecosystems presented in the Legend?
2. Today, where would you find ecosystems like the ones described in the early part of the Legend?
3. What changes occurred in the valley?
4. What caused the changes that occurred in the ecosystems described in the Legend?
5. What evidence of human activity or land-use can you describe from the Legend?
6. Why does this species think they can't survive in the valley anymore?
7. What is an omnivore?
8. What is the name of this species?

"The future will either be green, or not at all. This truth lies at the heart of humankind's most pressing challenge: to learn to live in harmony with the Earth on a genuinely sustainable basis."

Jonathon Porritt,
in Save The Earth

Journal Entry: Record a reflection in the Student Reflection Journals that describes your discussion.

Legend of a Valley: Fish Creek

by Tim Cartmell

It was peaceful in the pre-dawn darkness. The dew beaded on my nose as I poked at the freshly turned soil beneath my claws. I was tired and hungry after a long journey from the mountains, some 80 kilometres to the west. Nestled in a thicket of scrub willows and alder trees, I waited anxiously for first light and a chance to familiarize myself with these new surroundings. Although I had never been here before I felt as if I had come home. This was the place my mother had told me about in the legend of the valley. It was a story her mother had told to her and had been passed down from generation to generation for more than 100 winter sleeps. It was the story of a valley carved out wide by a glacier and then cut deeper by a fast flowing creek.

The water was cold and clear and provided a banquet of fresh fish. In the early spring, hungry after a winter's sleep, one could catch spawning Rainbow Trout as they waited their turn in pools below beaver dams and small rapids. Later in the spring, a run of spawning suckers were often so thick it was said you could cross the creek on their backs and not even get wet. Again in the fall, the creek provided much needed food to fatten up for the winter as Bull Trout returned year after year. It was not surprising that this place became known as Fish Creek. On the colder north facing slope, spruce trees grew tall and strong, while on the drier and warmer south slope, aspen poplar trembled in the breeze. In the open, driest and hottest areas, native grass grew and small ground cover plants thrived where the trees could not get enough water. Hidden in the grasses were bountiful harvests of wild strawberries and at the forest edges large patches of bear berries and saskatoons. All this diversity of vegetation in such close proximity attracted game of all sorts and sizes. Whitetails, mule deer, moose, beaver, cottontails and ground squirrels all foraged in the valley along the creek. They were wary of the wolves, cougar, coyotes and lynx who were also present. My mouth always watered when tales were told of a freshly killed deer that was buried and guarded until the flesh was ripe and tasty. Fish Creek was indeed a great place to be an omnivore.

"In every deliberation, we must consider the impact of our decisions on the next seven generations, and on those faces that are yet beneath the ground."

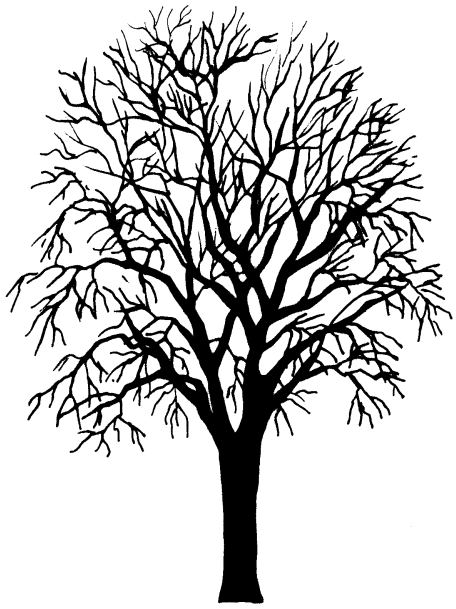
The Great Law
of The Six Nations
Iroquois Confederacy

But it was also a sad tale of sudden change and stern warnings about not venturing back there. A long hot summer had produced a frugal dried up berry crop and game was scarce and difficult to find. Long tiring days, seeking out a meager existence, sometimes involving traveling nearly one hundred kilometres had taken it's toll. If the legend was only half true, the hunger driving me would be satisfied and I would be rewarded with a full stomach and restful winter sleep. Besides, how much could a ten thousand year old valley change in a mere hundred years?

As dawn approached, a fog descended providing cover as I slipped out of the thicket. I gained a sense of security as I raised my nose and breathed in deeply. Mixed in the array of odours were the sweet smells of rotting logs, damp earth and frosted leaves and flowers. The fall trout run should be in full swing. I chose a small deep pool below a narrow fast rapid. The fish would be forced to swim up this channel and would be easy to catch. The water was cold but not quite as clear as in the legend. Thick mats of aquatic vegetation choked the pool, making catching fish more difficult. The fish were here all right, but not in the numbers I had anticipated. Concentrating on the task at hand I failed to notice that the sun was now fully above the horizon warming the air and dissipating the fog. I was startled by a strange whirring sound and the odour of an unfamiliar omnivore. My first instinct was to retreat but two more whirring sounds passed by on the bank above me.

My curiosity was aroused and I ventured up the embankment to the forest edge. I came upon a narrow, hard surfaced and almost perfectly smooth pathway. I ambled along the route for a short distance when my curiosity was replaced by a sense of urgency and terror. More whirring sounds and strange smells were followed by loud shouting and convinced me that my presence had attracted a lot of unwanted attention. I bolted down the slope and crossed the creek. I emerged from the aspen forest and into a field. Mixed in the grass was a tall, invader plant species with sharp prickles. It seemed to be taking over. Some of the natural vegetation in the legend did not grow here any more. I paused to catch my breath and regain some composure in a cut off creek channel. The thick wall of vegetation provided some security while I considered my options. The Fish Creek valley did have a supply of food, shelter and water but I could not stay in the valley of the legend. My kind could not survive here any more.

I too would have a tale to tell, about the valley known as Fish Creek, when I returned to my mountain home - but my tale would be about a different valley than the one of a hundred winter sleeps ago.



2.6 Introduction To The Field Study Methodology

Objective:

To familiarize students with field study data collection methods.

Teacher Instructions:

After completing a scavenger hunt (activity 4.1.2 p.54), the students will explore two or three ecosystems and conduct a detailed exploration of each. After establishing a transect and quadrat in each ecosystems they will complete an Ecosystems Card (Appendix C3) as they gather data. They will round out the day with the active protected areas role playing game.

2.6.1 The Ecosystem Card

Objective:

To familiarize students with the methodologies, equipment and tests used to gather data during the field study, along with the materials used to record the data they collected.

Time Required:

20 - 30 minutes

Teacher Instructions:

Using an ECOSYSTEM CARD (Appendix C3), each group of students will conduct tests and make observations to gather data on the ecosystems they visit. Make an over head and review the Ecosystem Card data sheet with the students. Explain that each role in the group has specific tasks to complete, but that they should assist each other in completing these tasks. Be sure they understand how to enter data. Indicate there will be some preparatory study in class about how to conduct some of the tests. According to scientific team roles, the Ecosystem Cards contains space to record observations about:

Curator

Complete masthead information: Record data about the ecosystem, date, weather, etc.
Scale drawing of entire transect: Use the clinometre to draw a scale cross section profile, that demonstrates the height variance of objects along the transect.
Other: Record data on the ecosystem card as it is collected.

"When you look out the other way towards the stars you realize it's an awful long way to the next watering hole."

Loren Acton,
Shuttle Astronaut

Photographer

Slope: Use the clinometre to determine the angle of the slope for the entire transect line.
Aspect: Use a compass to determine the direction that your transect and quadrat faces.
List equipment and materials used.
Other: Complete colourful rubbings of items in the area being explored. Record the entire event with photographs, slides or video.

Researcher

Temperature: Use air and soil thermometers to record temperatures 1 metre above ground, at ground level and below the ground level within the quadrat.
Light: Use a light metre to measure light intensity in a variety of locations within the quadrat.

Zoologist

Wind: Make observations about wind strength and the factors that influence the impact of wind within the quadrat area.

Evidence of biotic features:

Collect data on observations about biotic features in the quadrat area such as animal browse markings, nests, burrows, tracks, scat, animal trails, scratch marks on trees or logs, etc.

Botanist

Soil profile: Use a soil plug to collect soil and diagram a cross section of the soil within the quadrat.
Soil compaction: Determine if the soil has a high, medium or low degree of compaction ability within the quadrat area.
Soil moisture: Determine if the moisture level in the soil is high, medium or low within the quadrat area.
Soil pH: Use pH paper, pH pens or pH testing kits to determine the pH of the soil at various places within the quadrat area.

Everyone is expected to make contributions about the following:

Detail of area in quadrat, including plant identification and populations: Draw an accurate scale diagram of the interior of the quadrat area. This should reflect consideration of all the criteria mentioned in this list.
Evidence of human impact: Record observations about the impact humans have had on the overall area. Not just in the present, but make reflections about obvious historical uses by looking around the area for evidence of human activity.
Aesthetic features: Describe the aspects of the quadrat area that are appealing to humans. These are features that make this ecosystem unique from all others, and that people enjoy when in this ecosystem. These could be wildflowers or unique plants, colourful leaves, unique animal features, sounds, smells, etc.
List any unique observations.
List the land uses that are present: Generate a list of land uses you observe in the area.
The following activities are designed to help prepare students for collecting data, that goes onto the ecosystem card, on the field study.

2.6.2 Soil pH Study
(Demonstration or Student Lab Activity)

Objective:

Soils have varying acid and base levels. This is a result of both the parent material and the plants that grow there. The following activity is intended to prepare students for collecting and testing in the field. (Appendix C4)

Time Required:

30 minutes

Teacher Instructions:

Conduct the following lab activity.

Procedure:

1. Number ten sample containers 1 - 10. Fill 5 with mixtures of water at various pH levels (use varying proportions of baking soda for base and vinegar for acidic) and 5 with mixtures of household items of varying pH such as sugar/water, flat soda drink, soap/water, plant fertilizer/water, food colouring/water.
2. Ask the students to test each mixture with pH indicator paper, pH solution testing kits or pH pens.
3. Instruct the students to record their results on the data sheet and enter each item tested on the pH scale.
4. Share the data and discuss any variations in data for the same samples.
5. Summarize with a class discussion and journal entry.

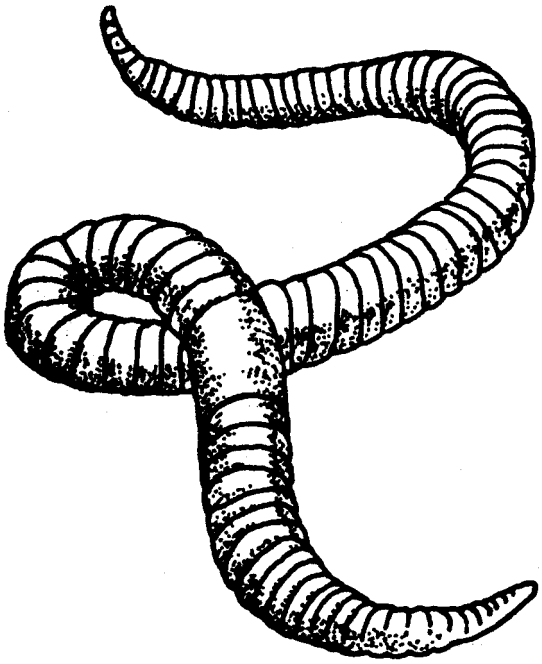
"The raw materials for making glass are abundant, but it takes about 38 gallons of oil to heat them sufficiently to produce 1 ton of finished glass. Throwing away bottles is therefore a considerable waste of energy."

Seymour, J & Girardet, H.
Blueprint
For A Green Planet

2.6.3 Moisture Content of Soil (Demonstration)

Objective:

The moisture content of soil will determine, to a great extent, what is able to live and grow in that soil. A lack of moisture is what prevents trees from growing in grassland environments, for example. The following activity is intended to prepare students for the collection and testing of samples for moisture content. (Appendix C5)



Time Required:

10 - 15 minute class followed by a 20 - 30 minutes class the next day.

Teacher Instructions:

Conduct the following lab activity.

Procedure:

Number 3 vials (film canisters) and fill one with sand, one with clay and one with topsoil. Be sure each sample contains a normal amount of moisture.

1. Record the mass of each vial on a worksheet (column A - mass A).
2. Spread each sample out on a sheet of paper and leave them to dry overnight.
3. When the samples are dry measure the mass again and record the information on the worksheet (mass B).
4. Determine the mass of water lost from each by completing the following steps.
   Mass A minus Mass B = Mass C (mass of H_20)
   Mass C divided by Mass A multiplied by 100 = % of water in sample
5. When all data is gathered and recorded, speculate on which samples might be best for plant growth and what type of plant growth.
6. Summarize with a class discussion and journal entry.

"My first view - a panorama of brilliant deep blue ocean, shot with shades of green and gray and white - was of atolls and clouds. Close to the window I could see that this Pacific scene in motion was rimmed by the great curved limb of the Earth. It had a thin halo of blue held close, and beyond, black space. I held my breath, but something was missing - I felt strangely unfulfilled. Here was a tremendous visual spectacle, but viewed in silence. There was no grant musical accompaniment, so triumphant, inspired sonata or symphony. Each one of us must write the music of this sphere for ourselves."

Charles Walker,
American Astronaut

2.6.4 The Effects of Wind

Objective:

To familiarize students with the types of objects that influence the impact wind has on the natural world. The intent is for students to recognize the direction wind usually comes from and observe how items such as trees, slope, buildings, direction and terrain influence wind. (Appendix C6)

Time Required:

20-30 minutes

Teacher Instructions:

Conduct the following lab activity. This activity will require the class to be prepared to go outside when it is windy. Create a map of the school grounds that students use to show the location of the items they observed.

Procedure:

1. Attach a plastic streamer (15 cm long) to the end of a ruler (30 cm long).
2. Locate an object identified in the data chart.
3. Hold the streamer and ruler at various points around the object. Observe how the streamer behaves.
4. Record how wind is influenced by that object.

"The future of our children depends on our ability to learn to live in harmony with nature and each other. Sustainable development means that we cannot continue to satisfy our own needs at the expense of those of future generations."

Gro Harlem Bruntland
from Our Common Future

Observations

Use the data gathering sheet (Appendix C6) to record your observations.

Journal Entry:

When all the data is collected discuss how items such as trees, slope, buildings, direction and terrain influence wind. Summarize this discussion in the Student Learning Journals.

2.6.5 Constructing Clinometres and Using a Line Transect to Determine Forest Canopy Height

Objective:

To familiarize students with the materials used to measure aspect and the height of objects during the field study.

Time Required:

50 - 60 minutes

Teacher Information:

This pre-trip activity has been divided into three parts. The first part teaches students how to construct and use a clinometre to measure the aspect (angle) of a slope. The second part teaches students how to use the clinometre to estimate the height of objects. The third part teaches students how to estimate the height of objects and structures along a transect.

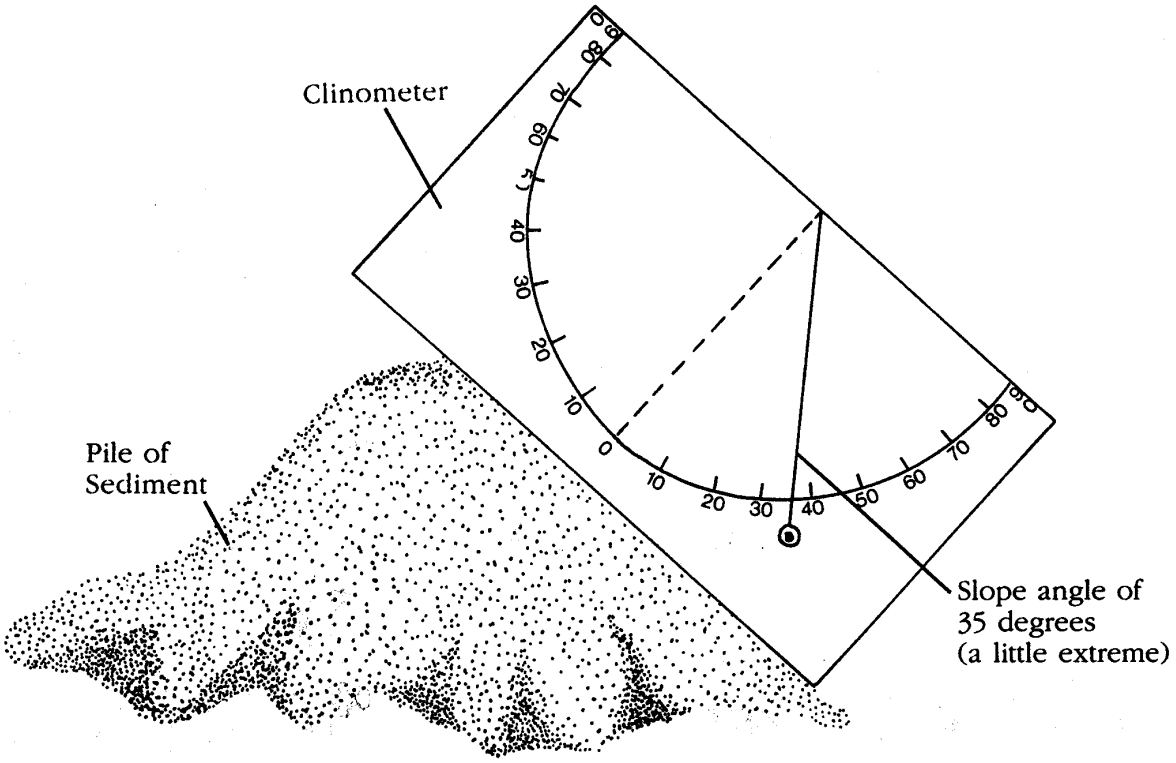
Activity No.1 - Constructing a Clinometre (Appendix C7)

Materials

photocopies of the clinometre faceplate
cardboard backing
spring or fishing line
small metal washers
glue
scissors
single hole punchers

Assembly

1. Photocopy the required number of clinometre faceplates. (Appendix C7)
2. Cut out the clinometre template and a cardboard backing that is the same size.
3. Glue the clinometre template to the cardboard backing.
4. Punch a hole in the clinometre at the centre of the base line.
5. Measure and cut a piece of string or fishing line about 11 cm long.



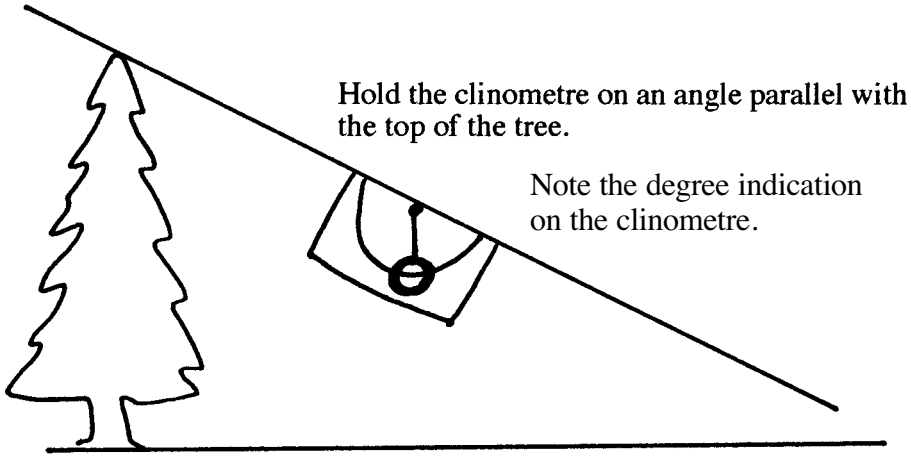
6. Tie a small washer onto one end of the string and tie the other end through the hole in the base line.
7. Set the length of the string such that the scale appears inside the hole in the washer when the washer in hanging down the front of the clinometre.

How to use a clinometre

1. Hold the base of the clinometre up so that it runs parallel with the slope being measured or one end on the base lines points to the top of an object being measured for height.
2. Note the degree of slope the plumb line falls to. This is the angle or degree of slope for the hillside being measured. This is referred to as the aspect of the slope.

Activity No. 2: Measuring the Height of Trees and Other Objects.

To determine the height of something using the clinometre, first measure 9 metres out from the base of the object to be measured. Then set your clinometre so that the flat part of the semi-circle runs parallel to a line from the top of the object down to the location you are standing. Read the scale on the clinometre as if measuring the aspect. Note the degrees on the scale and use the table below to estimate the height of the object being measured.



Degrees of Slope (at 9 metres from the base of the object)	Height (in metres)
10 degrees	1.5 metres
20 degrees	3.0 metres
30 degrees	5.0 metres
40 degrees	7.5 metres
45 degrees	9.0 metres
50 degrees	11.0 metres
60 degrees	15.5 metres
70 degrees	25.0 metres
80 degrees	51.0 metres

Activity No. 3 - Using a Line Transect To Determine the Forest Canopy Height (Appendix C8)

Objective:

To familiarize students with the use of a transect and the materials used to measure the height of objects along the transect.

Time Required:

50 - 60 minutes

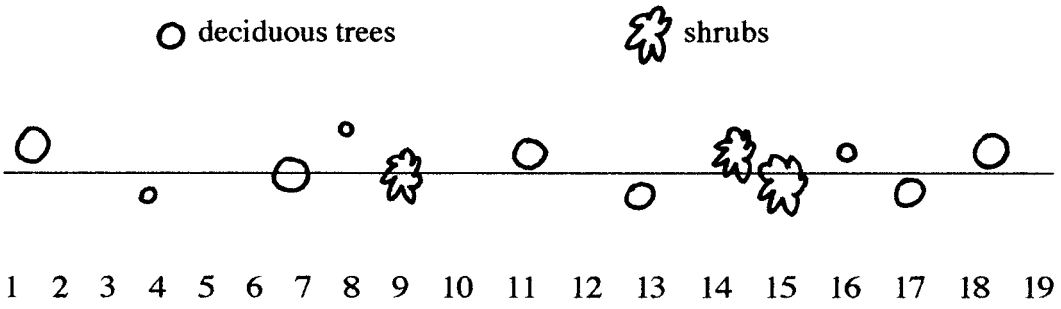
Teacher Information:

Once the students are familiar with using the clinometres introduce the notion of a transect. Divide them up into groups of 4 or 5. Give each group a 20 metre rope, marked with tape at I metre intervals. Go outside and ask the students to attach one end of the marked rope to a peg. String the marked rope out straight to its full length. Have it touch as many other trees or bushes as possible. On a data sheet (Appendix C8) mark the locations and the distances between all the significant items along the transect. (Note: The transect includes the area one metre out from both sides of the actual rope.)

Using the clinometre, determine the height of each tree or shrub. Identify each tree. (students may refer to each as either coniferous or deciduous). Use this information to draw a side profile on the transect line.

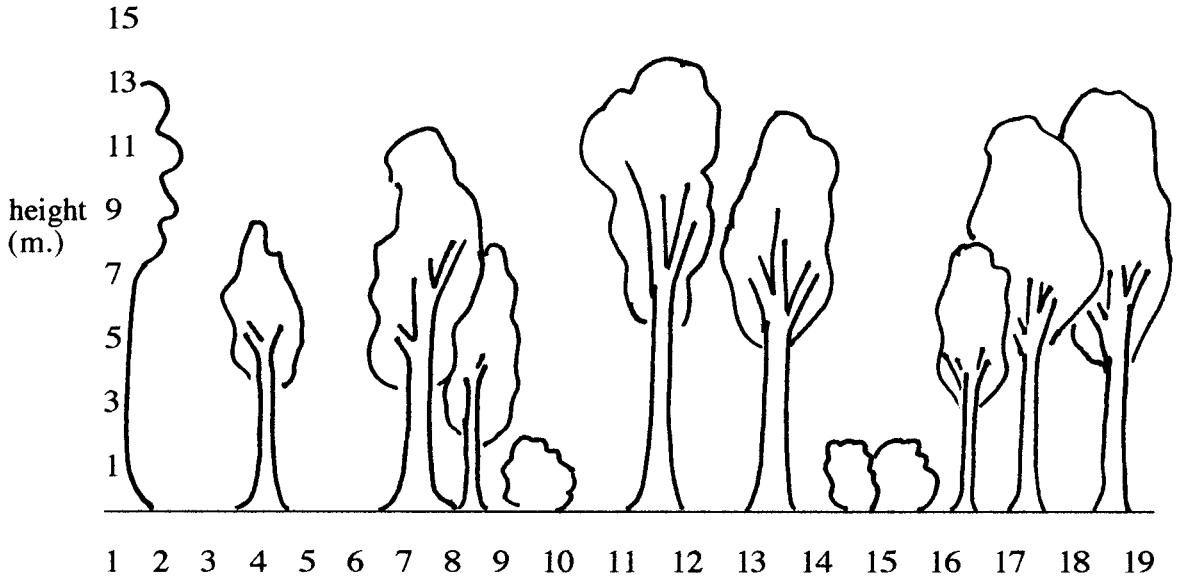
ASPEN WOODLAND

Line Transect (top view)



transect distance in metres

Line Transect (profile)



transect distance in metres

2.7 Describing An Ecosystem

Objective:

To provide students with a list of questions or criteria they would use to help define an ecosystem when they visit it for the first time. (Appendix C9)

Time Required:

40 - 45 minutes

Materials:

Alberta Flora and Flora Poster Series of the Natural Regions of Alberta. Contact FEESA to order your set of six for $20.00.
(780-421-1497) Edmonton.
(403-220-2819) Calgary.
Contact your Science Coordinator or tacher librarian to see if your school has copies already.

Teacher Instructions:

1. Instruct the students to get into their scientific teams. Circulate one Alberta Flora and Fauna poster to each group of students. Include other posters or resource materials that you may have. Be sure each group has a different environment or ecosystem.
2. Challenge each group to develop a list of questions that could be reduced to five questions, that when asked, would result in information that describes any ecosystem they might visit.
3. Ask each group to present and post the questions they developed.
4. Switch posters and resource materials, so they are now working with a different ecosystem. Ask them to apply the questions they developed at the last poster, to the new poster.
5. Do the answers give a complete description of the ecosystem they now have?
6. How could they revise their questions to improve them?
7. Create three food webs that contain at least ten species in each web.

Journal Entry:

Summarize the activity with an entry in their Student Reflection Journals that includes:

- The five questions they would ask when entering a new ecosystem?
- A comparison of two of the ecosystems that describes the similarities and differences between the ecosystems.
- At least one food web or food chain that contains at least ten species (be sure there are examples of producers, consumers and decomposers in the web or chain).

Describing An Ecosystem

Some possible questions to ask when exploring any ecosystem could include:

1. What are the primary abiotic features?
2. What are the primary biotic features such as:
   What are the main producers?
   What are the main consumers?
   What are the main decomposers?
3. What unique adaptations do the plants and animals have?
4. What are the hardships and challenges organisms in this ecosystem face?
5. How does the ecosystem change over the course of the seasons?

These are arranged as a student worksheet in Appendix C9.1

2.7.1 Alberta's Natural Regions

Alberta is comprised of six distinctly different natural regions, each having several sub-regions. Classification of these regions is based on geology, landforms, soil, hydrology, climate, vegetation and wildlife. For more information an the six eco-regions described here, visit the Recreation and Protected Areas Division website at http://www.gov.ab.ca/~env/parks.html or see a copy of Alberta's Parks and Protected Areas (ISBN 0-7785-0125-6).

Grasslands Natural Region, located in the south east corner of the province is characterized as hot, dry and windy. Exposed badlands, bedrock, sandstone and large flat plains make up the geography. Wildflowers, grasses and shrubs are common plants. Wildlife includes cottontail, pronghorn and ground squirrel along with an abundance of birds. This ecosystem comprises about 12% of Alberta's environment.

Rocky Mountain Natural Region lies along the Continental Divide. Here fast flowing streams and rivers dissect towering mountain ranges. Thick coniferous forests are found at lower elevations, and an alpine tundra at higher elevations. Common vegetation includes Douglas fir, aspen, lodgepole pine and grassy meadows. Wildlife that live in this region include elk, bighorn sheep, deer, coyote, moose, osprey and grizzly bears. This ecosystem comprises about 6% of Alberta's environment.

Foothills Natural Region is comprised of rolling hills and ridges that run parallel to mountains. This area receives more precipitation and is cooler in the summer than other regions in the province. Its coniferous forests, populated by white spruce, black spruce, lodgepole pine and subalpine fir, are home to a wide variety of birds, black bears, grizzly bears and elk. This ecosystem comprises about 12% of Alberta's environment.

Boreal Forest Region is the largest natural region in Alberta. Vast stands of aspen, balsam poplar and white spruce are broken up by lakes and large areas of muskeg where black spruce and tamarack are the dominant tree species. These ecosystems are home to an extensive range of wildlife that include moose, hare, lynx, weasel, wetland birds, wolves, beaver, ermine, woodland caribou and an abundance of birds and insects. This ecosystem comprises about 60% of Alberta's environment.

Canadian Shield Region reaches into Alberta from the Northwest Territories on its north east border. This small region is formed of granite covered with thin soils, patchy coniferous forests, shifting sand dunes and small shallow lakes. Common wildlife include bear, beaver, muskrat, lynx, wolf, moose, bald eagle, ptarmigan and a wide variety of other birds. This ecosystem comprises about 2% of Alberta's environment.

See Appendix E7 for a list of some of the specific indigenous plants and animals from Alberta's Natural Regions.

2.8 What Are Protected Areas?

Objective:

To introduce the concept that people value different things in different ways and that in order to ensure an area is "safe", or "secure" from damage, certain precautions are required.

Time Required:

50 - 60 minutes

Teacher Instructions:

1. Make copies of **What Is A Protected Area** one (Appendix C10) and **What Is A Protected Area** two. (Appendix C10.1)
2. Circulate copies of **What Is A Protected Area** one to each student.
3. Ask the students to think of somewhere that is very important to them. This could be their bedroom, a local natural area, a cottage, weekend cabin or particular camping destination, for example.
4. Ask the students to answer the following questions with this place in mind.
   - Describe this important area without naming it.
   - Why is it so important to you?
   - How do you ensure it never gets damaged or destroyed?
   - What would you do if a friend threatened this place?
   - Is this place important to other people? If so who and why?
   - How do you indicate to others that this place is important to you?
5. Collect the completed sheets, number them consecutively and post the sheets on the wall, without any students names on the sheets.
6. Hand out copies of **What Is A Protected Area** two.
7. Ask the students to move around and read the posted sheets. They can ask their classmates questions, that can be answered with a yes or no, in an effort to determine who wrote each posted sheet.
8. Record their guesses on the sheet entitled "**What Is A Protected Area** two" by writing the name of the person they think filled out the sheet they are reviewing, beside the sheet number on their tally sheet.
9. After a few minutes, ask each person to write their name on the "**What Is A Protected Area ?**" sheet they made.
10. Discuss the common points that students wrote for each of the questions on the "**What Is A Protected Area** one?" sheet.

Today 75% of humanity live in urban settings and it's estimated that the average Canadian spends 85% to 95% of their lives indoors. ÒWe need to spend more time immersed in the natural world to both better understand how it works and how we as human beings are connected to the natural systems that sustain life on this planet."

Government of Canada's Green Plan and Creating an Outdoor Centre

Discussion should include the following points:

- What sorts of protected areas are values by students?
- Why are these areas important?
- Why is there so much variance in what people value?
- How do you demonstrate to others that this is an areas you protect?

2.8.1 Protecting A Natural Area

Objective:

To introduce some criteria for determining the level of protection an area should receive.

Time:

20 - 30 minutes

Teacher Instructions:

1. Re-introduce the scientific team, group format, they will be used during the field study.

Scientific Team

curator, prepares and labels artifacts gathered, keeps track of equipment
photographer, takes pictures, video and record interviews of the days events
researcher, organizes the collection of data into charts and graphs
zoologist, collects and records qualitative and quantitative data on animal species
botanist, collects and records qualitative and quantitative data on plant species
all students are expected to enter data on the ecosystem cards.

2. Now introduce the notion of protecting a part of the natural world. Using local issues, examples of existing protected areas and the trends that emerged from the class discussion about what they value and want to protect, discuss the following:

- What is a protected area?
  An area that is afforded some measure of protection, in terms of the land uses permitted there, that will ensure its relative ecological health and sustainability into the future. What results are a variety of protected areas that permit different activities and types of interaction. See "Alberta's Parks and Protected Areas" document ISBN 0-7785-0125-6, available from Alberta Environment, for details about the types of protected areas in Alberta.

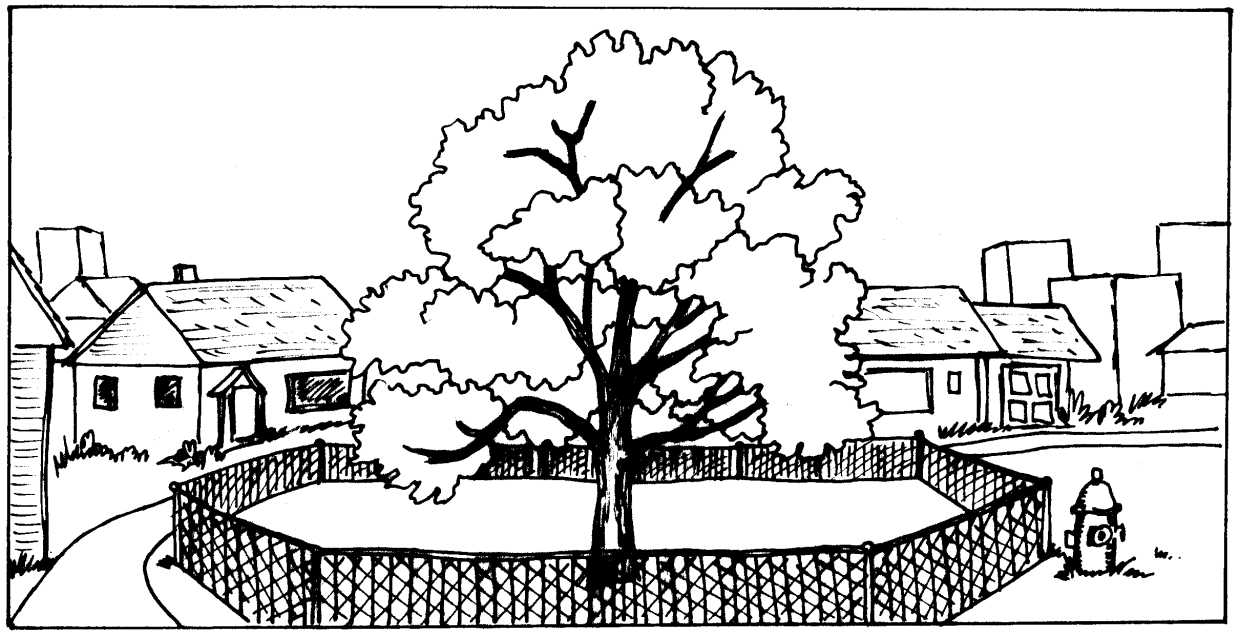
- Why should certain natural areas be protected?
  Areas whose relative health and sustainability are being threatened by a variety of land uses are afforded a high level of protection if they contain a wide variety of ecological diversity, extensive populations of unique or special species and an extensive cultural background. Areas that don't have this heritage value are afforded less protection from a wider range of land uses.

- How important is ecological diversity in determining the level of protection?
  Ecological diversity is a significant factor in determining the level of protection an area receives. An area rich in ecological diversity sustains a wider range of natural life forms. Consequently, the types of land uses that are permitted to occur there must not compromise the relative health of the ecosystems that exist there.

Protected Areas Concepts

The following concepts can be explored through studying protected areas.

- anthropocentrism
- biocentrism
- ecocentrism
- biodiversity
- carrying capacity
- conservation,
- preservation and protection
- ecological integrity
- ecological succession
- economics of protected areas
- ecosystem management
- ecosystem monitoring
- ecosystems and change
- ecotourism
- fragmentation
- gap analysis
- island biogeography
- minimum viable population
- restoration ecology
- single species management
- species at risk
- special features
- sustainable development
- wildlife corridors



- How important are species population numbers in determining the level of protection? The size of populations (plants and animals) within an area is an important consideration because the larger these numbers, the larger the available gene pool is, to maintain the genetic strength of the species involved.

- How important is the size of a protected area in determining if it should be protected? The size of the land base that serves as a range for the plants and animals that live there is an important consideration because every species has different requirements. If an area offers sufficient space to sustain populations, particularly populations at risk, it is considered to be more worthy of protection.

- Are there various levels of protection that allow an activity to occur in one area, but not in another? Yes. Depending on the level of protection an area should receive, certain land uses are allowed. Provided the land use under consideration does not compromise the ecological integrity of the area, it may be considered.

- What land uses or activities should be allowed to occur in protected areas?
- To what level should these uses be permitted if they threaten the protected area?
- What are the ties between human health and protected areas?
- Is it important to protect an area that **You** might never visit?

3. Ask each group to generate a list of between 5 and 10 items, or criteria, that could serve as indicators for determining whether an area should be protected or not.

4. Ask each group to circulate through all the other group lists and add anything they thought of that could be added to the list they are reviewing.

5. Ask each group to present their complete list to the other groups in the class.

6. Ask the students to take their list home and discuss it with their parents.

7. Back in class, develop one set of rank ordered criteria (5 - 10 items), for determining the level of protection an area should receive, that the entire class agrees on. This list will be used during the field study to assist in evaluating the ecosystems they visit.

Journal Entry:

Record the list developed in this activity in their Student Reflection Journal.

Optional activity:

Review the data gathered by scientists on protected areas in Alberta. Compare the list the class produces with the criteria scientist use to determine the level and type of protection an area might receive.

Criteria For Determining Protected Areas

What are some guidelines, or criteria, for determining whether an area should be protected or not?
The following could be measured:

- Is the area a healthy example of a natural Alberta landscape?
- What is the level of biodiversity?
- Does the area contain significant population numbers of a wide range of species?
- Is the size of the area large enough to sustain the plants and animals that live there?
- Does the area contain special or unique natural, cultural or heritage feature worth protecting?
- What is the level of human disturbance or presence?
- Does the area have access to wildlife corridors that create connections to other wild or protected areas?
- What are the traditional uses of the area?
- To what extent are human needs (such as natural resource extraction) satisfied through the area?

2.8.2 Land Uses And Activities In Protected Areas

"In Canada, we cut an area of forest equal in size to Vancouver Island every four years."
The Pollution Probe Foundation.
The Canadian Green Consumer Guide.

Objective:

To introduce a variety of land use possibilities and their impact on ecosystems.

Time Required:

Community tour 30 - 60 minutes, class discussion with slides 20 - 30 minutes

Teacher Instructions:

1. As a class, go for a tour of your community, or at least view your community from various points, while remaining on school property.
2. Make a list of all the land uses that you see.
3. Back in class review and share the lists that are produced.
4. Through the use of slides (Appendix C11), add to these lists of land uses.
5. Divide the class up into their research groups and designate a different type of ecosystem for each group.
6. Challenge each group to design a land use map (on grid paper) of an area, such that all land uses, brainstormed by the class, are included without compromising the relative health of the ecosystem.

Students will most likely indicate they can't include all the land uses on the list without compromising the relative health of the ecosystem. If this is the case, develop a prioritized list of the land uses and their impacts. Then re-design your map in such a way that everyone can co-exist together.

2.9 Vocabulary

Objective:

The following vocabulary will be used throughout the field study. It's expected that students will have a working knowledge of these terms. The following resources were used to develop these definitions:
The Oxford Concise Dictionary of Ecology
by Michael Allaby, Oxford University Press (1996)
The Oxford Concise Dictionary of Zoology
by Michael Allaby, Oxford University Press (1996)
Dictionary of Biology
by M. Thain and M. Hickman, Penguin Books (1994)
Gage Canadian Dictionary,
Gage Educational Publishing Company, (1997)

Time Required:

Varies.

Teacher Instructions:

There is a significant amount of vocabulary involved with this field study. This list, with definitions, is designed to help students sort the vocabulary into meaningful groups so that it can be used successfully for pre-visit activities, the field study day, and post-visit activities.

General Ecosystem Terms

abiotic: The non-living components of the environment (physical and chemical), such as air and water.

adaptation: A structure or behaviour that increases an organism's chance of surviving or reproducing in a particular environment.

biodiversity: The variety of life on Earth; most commonly, the genetic variability within individual species, variety of living species; and the variety of different ecosystems.

biotic:
The living components of the environment; in other words, all other organisms in the environment.

community: A group of interacting populations of two or more different species that live together in a particular environment.

ecology: The scientific study of the inter-relationships among organisms and between them.

ecosystem: A network or system of interdependent living (biotic) and non-living (abiotic) things.

environment: The complete range of external conditions, physical and biological, in which an organism lives.

humus: The decomposed (or decomposing) organic material (usually by bacteria and fungi) found in soil.

micro-environment: A small area of an environment that has different conditions (such as temperature and/or humidity) compared with the larger environment of which it is a part.

organism: A life form.

population: A group of organisms, all of the same species, which occupies a particular area.

Measurement Terms

aspect: The directional orientation of a slope which creates differing situations of heat, light and amount of sunshine.

quadrat: A basic ecological sampling unit, ranging in size from one square metre in grasslands, to 10 square metres in forested areas. These smaller units of measure are used for making accurate estimates of the biotic and abiotic features within an ecosystem.

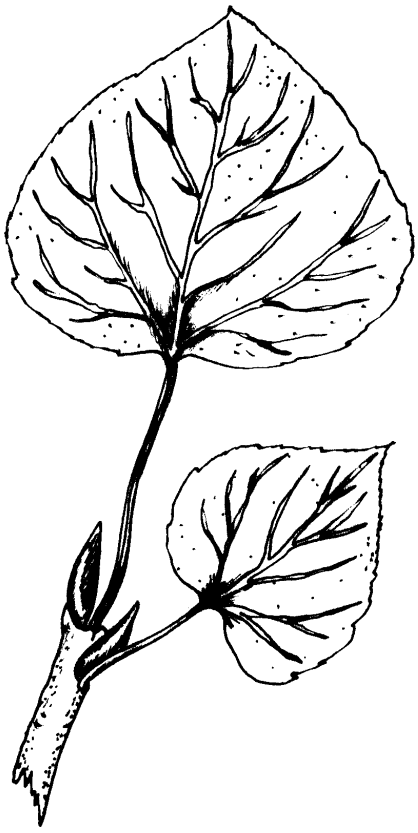
slope: The angle of an area of land.

transect: (1) A line used in ecological study to provide a means of measuring and representing, geographically, the distribution of organisms. Recordings are made at regular intervals. Transects are particularly useful for exploring transitions and the distribution of living and non-living things across an ecosystem. (2) A technique for estimating populations that involves running a straight line of string through the area being studied. At regular intervals along the string, every organism that touches the string, or grows directly above or below it is identified and counted.

Food Web Terms

decomposer:
An organism that feeds (to gain energy and nutrients) on material that had once been alive.

deciduous: Plants whose leaves fall off annually, usually in the autumn.



Aspen Poplar

coniferous: Seed-bearing plants that produce cones and bear leaves all year round.

consumer: An organism that obtains its food (to gain energy and nutrients) by eating other organisms.

fauna: All the animal species of a given area.

flora: All the plant species that make up the vegetation of a given area.

producer: An organism that is able to manufacture food from simple inorganic substances.

Land Use Terms

aesthetic features: Sensory aspects of a landscape associated with its natural beauty and wonder.

conservation: The process of managing human use of the environment to ensure that heritage values are considered and such uses are sustainable.

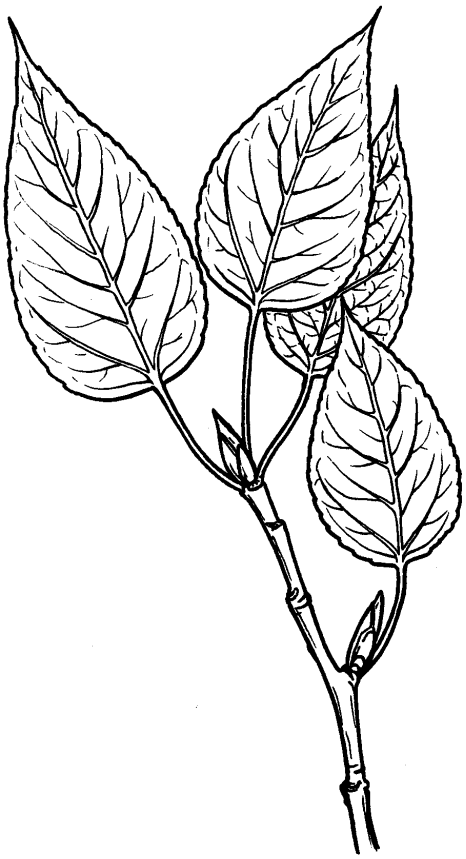
indicator species: A species whose ecological requirements are well understood and where changing population numbers will indicate a particular environmental condition or set of conditions. Indicator species can also give a good indication of how other organisms may be surviving.

land-use: Any behavior or activity that occurs on a parcel of land.

protected area: Protected areas are natural landscapes that are explicitly legislated to preserve natural heritage values. Management guidelines and monitoring programs must ensure the long term preservation of biodiversity. Environmental diversity (biodiversity) is understood to include all species of plants, animals and other organism, and the habitat, and ecological processes upon which they depend. Protected areas are internationally recognized as one of the cornerstones of biodiversity preservation.

stewardship: Management of the heritage of our natural spaces, species and culture in such a way that it can be passed on, intact, to future generations.

sustainable: Management that ensures that the present uses (human and otherwise) of an area and its resources, do not compromise the future health, availability and prospects for future generations.



Balsam Poplar

2.10 Class Discussion About The Field Study

Objective:

To conduct a class discussion focusing on the specifics of the actual field study day.

Time Required:

30 - 40 minutes

Teacher Instructions:

Discuss this checklist of items at school prior to the field study day:

___ In Alberta a protected area has government legislation to ensure protection or enhancement of ecological integrity and biodiversity. This allows the government to manage wildlife species and to permit specific uses of the land area.

___ Discuss how provincial parks and other protected areas are different from your local parks. *These areas are part of a plan to set aside a portion of the province's landbase of representative natural systems. This will help preserve the biodiversity of Alberta's natural environments for future generations to enjoy.)*

___ Discuss the value or importance of provincial parks and the various types of protected areas.

___ Discuss the purpose of provincial parks and other types of protected areas. At the present time there are several types of protected areas, each with its own set of regulations and permitted activities. The future Natural Heritage Act will place all protected areas legislation under one act rather than the many acts that now protect areas. All protected areas should provide for preservation, heritage appreciation, outdoor recreation, and tourism.

The emphasis and priority of these four mandates varies with the type of protected area.

a. Provincial Parks preserve and protect natural heritage while providing opportunities for recreation and heritage appreciation. Heritage Appreciation, Outdoor Recreation, Tourism. These vary depending on the park.

"If a child is to keep alive his inborn sense of wonder, he needs the companionship of at least one adult who can share it, rediscovering with him the joy excitement and mystery of the world we live in."

Rachel Carson

b. Wildland Provincial Park are large land areas that preserve and protect natural heritage, while providing opportunities for back-country recreation and experiencing nature in an undisturbed state. Preservation, Outdoor Recreation, Heritage Appreciation, Tourism.

c. Natural Areas maintain ecological integrity and biodiversity while permitting compatible activities. Preservation, Heritage Appreciation, Outdoor Recreation, Tourism.

d. Provincial Recreation Areas provide outdoor recreation and tourism opportunities while helping to protect natural and scenic qualities of nearby protected areas. Outdoor Recreation, Tourism, Preservation, Heritage Appreciation

Have the class make a list of behaviors on the field study that would show respect for living things and a commitment to their care. This list could include:

- leave ant hills, nests and rotting logs alone and intact. These are homes for small animals,
- walk carefully around bushes and trees, not through the middle of them,
- stay on the trails,
- walk carefully, watching each step to avoid crushing small plants and trees.

___ Discuss outdoor safety.

- have a buddy that you spend the day with,
- always be in view of your teacher or parent volunteer,
- stay away from open water, the river and steep hillsides.

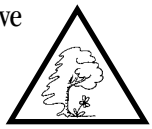
___ Discuss behavioral expectations.
As the Kananskis Country is visited by many people, we must be careful how we act there. Explain that they are ambassadors for their school. Review appropriate behavior, both indoors and outdoors. Discuss the part of Kananskis Country they will be visiting. Explain that the field study will be another school day, just at a different place. All the school rules apply. Remember that other schools may be there trying to work also.

___ Lunch
Discuss lunch procedures. Remind the students about bringing a garbage free lunch.

___ Discuss appropriate clothing for the day's activities. Review clothing needed to be appropriately dressed for the season and the activities of the day. Mornings in the shady forest will be cool and trails may be muddy and wet. Several layers of clothing, including a water resistant layer and a hat or hood, will provide the most comfort. Gloves or mittens will be important to keep hands warm. Boots or sturdy runners or shoes (with an extra pair of socks) provide more protection than sandals and canvas runners. Warm weather means hats and liquid insect repellent will also be required.

___ Discuss the rules for visiting a protected area. (see Appendix A2 for student copy)
These rules reflect the Alberta environment's mandate to protect and conserve our natural environment. Toward this end, it's very important to be aware of the following rules.

1. Wildlife live in this are because they are able to meet their needs for food, water and shelter. Feeding them is not necessary. In fact, it can create significant hardships for them because they become dependent on this food and the learned behaviors associated with this can also be dangerous for them.
Do not feed or harass wildlife. Observe them quietly instead.



"We know more about the surface of the Moon than we do about many of the biological communities we are so rapidly destroying here on Earth."

Peter Raven

2. Millions of people visit the Kananaskis Country each year. If each person took only one cone or picked one plant that still represents a very significant impact on the natural environment. Cutting, defacing, picking or removal of any plant, fossil, rock or other material is prohibited. Leave them behind for others to enjoy and for animals to use.

3. If each person threw their garbage on the ground it would be difficult to clean up and dangerous for wildlife who could confuse the litter for food. Litter should be placed in garbage cans or in your pocket if no garbage cans are available.

4. For as much as is possible, Kananaskis should remain a natural place. Wildlife are not accustomed to pets chasing them or threatening them with noise. For these reasons pets must be on a leash. This not only protects wildlife it also protects people and their pets as well.

5. To preserve and protect our natural environment we must be very careful with how we interact with the area. Open fires are a threat to habitat which includes animals and plants. For these reasons, campfires are permitted only in designated firepits located in some picnic areas.

The "Nature" of Science

3.0 Teacher Instructions For Planning The Field Study Day

"Nature" of Science Program
Interactions and Environments Field Study

3.0 Teacher Instructions For Planning The Field Study Day

3.1 Checklist For Planning The Field Study Day

___ Arrange transportation (carpool or bus) early. Confirm cost along with pick-up and departure times about one week prior to the field study day.

___ Review and revise the on-site activities to suit your specific needs.

___ Gather / prepare required equipment. Pack it so it can be easily transported.

___ Prepare student materials such as field study data collection sheets (ex: ecosystem cards), student reflection journals, pencils, paper, etc.

___ Complete the preparatory activities. Be sure to conduct a few of these activities outdoors to acquaint your students with learning in outdoor situations.

___ Divide your students up into groups of no more than five and select a volunteer leader for each group. Make name tags for everyone.

___ Send home and collect permission forms (see sample letter section 3.3).

___ Make a copy of the trail map for each adult volunteer.

___ Ensure all students have lunches and trail snacks. Please consider bringing garbage free lunches. Plastic re-sealable containers, drinks in cans or bottles, snacks or desserts in self-sealing plastic bags and lunch bags that are cloth are all re-usable, reduce the garbage produced in protected areasand are better for our environment.

___ Arrange for and prepare adult volunteers. Conduct an in-service after school for all volunteers prior to coming to Kananaskis Country.
This in-service would:
- explain and describe their role in the field-study day,
- provide volunteers with the materials they need for the day,
- orient them to the activities and the plan for the day and,
- orient them to any specific health or student concerns.

If this is not possible, as an alternative, prepare all the activity descriptions that each volunteer will require and send it home. Make several copies of this information to replace those that get inadvertently left at home.

___ Ensure all students are dressed appropriately for the weather.

___ Ensure students have:
- toque
- gloves
- extra socks
- sturdy footwear
- sweater
- rain jacket
- rain pants
- sun screen
- water bottle (filled)

___ Class discussion that reviews the role protected areas, clothing needs and behavior expectation.

___ Arrange any necessary school-based classroom coverage.

___ Arrange a field study site visit prior to the field study to become familiar with the site, any safety concerns, boundaries and teaching locations.

3.2 Planning The Itinerary For The Field Study Day

Please consider travel time from your school to and from the natural area you will visit for the field study. This may require you to alter the timing of the days events. Develop a timetable for the field study.

Time	Activity
_____	depart from school
_____	arrive at the field study site
_____	scavenger hunt
_____	grasslands ecosystem exploration
_____	summary discussion and student reflection journal entry
_____	lunch
_____	afternoon program
_____	explore aspen woodland ecosystem
_____	explore boreal forest ecosystem
_____	protected areas game
_____	student reflection journal entry
_____	gather together, inventory and return any borrowed equipment
_____	gather personal belongings together and travel back to school
_____	arrive back at school

3.3 Sample Parent Permission Form

The following is a sample parent permission form. Simply add the specific information for your field study date (bottom and top), field study location (bottom and top), whom cheques should be made payable to, along with arrival and departure times. Copy the letter onto school letterhead and send home to parents. Be sure to allow two to three weeks for them to be returned to school and have the information collated.

3.4 Safety Considerations

Kananaskis Country Environmental Education staff suggests the locales for field studies with safety and security as the main criteria when considering a location for all grade levels.

We recommend that teachers and/or chaperones have recognized and current first aid training as a requirement for bringing students into a wilderness area.

Hazards in the mountain environment of Kananaskis Country such as trail conditions, weather, and wildlife are unpredictable– so prepare accordingly. If you would like information on current trail, weather, and wildlife conditions contact the Barrier Lake Visitor Information Centre at 403=673-3985 or the Peter Lougheed Provincial Park Information Centre at 403-591-6345.

Other numbers to keep handy are:
Canmore R.C.M.P. 678-5516
Kananaskis Country Emergency Services 591-7767
Report a Poacher 1-800-642-3800

Date: _____

Dear Parents:

Grade 8 Field Study
The "Nature" of Science: Interactions and Environments

Presently in science, we are working on theme 6: Interactions and Environments. To accomplish some of the curriculum requirements for this unit, we will be going on a field study to explore and collect data on three different ecosystems.

Field Study Date: _____

Field Study Location: _____

_____

Department Time From School: _____

Arrive Time Back At School: _____

Cost: _____
Cost includes transportation, program development along with all props and materials needed for the field study. Please make cheques payable to

_____

_____

The field study will consist of experiments and activities that gather data about three different ecosystems. This data will be used to identify and understand the relative health of these ecosystems and explore methods students could take to protect them, thus ensuring their long term sustainability.

Volunteers are welcome. The students will be grouped, according to the type of research they will be conducting. The role of volunteers is to assist and facilitate their efforts. Instruction will be provided by site staff and teachers. A short orientation for parent volunteers will be offered prior to the field study. If you are interested in participating as a parent volunteer, please complete the lower portion of this sheet.

Grade 8 Field Study
The "Nature" of Science: Interactions and Environments

Please complete and return to school on or before _____

I _____
(parent / guardian)
give permission for

_____
(student name)

to attend the field study on _____
(date)

at _____
(locations)

_____ Yes, I am interested in volunteering for the field study.

_____ No, I am not able to volunteer on the field study.

The "Nature" of Science

4.0
Field Study Day

"Nature" of Science Program
Interactions and Environments Field Study

4.0 Field Study Day

4.1 Morning Program

4.1.1 Program Orientation

Objective:

To introduce the area and the program activities for the field study day.

Time Required:

15 - 20 minutes

Equipment provided by the Kananaskis country:

All props and materials for the orientation

Equipment provided by the School:

None

Teacher Instructions:

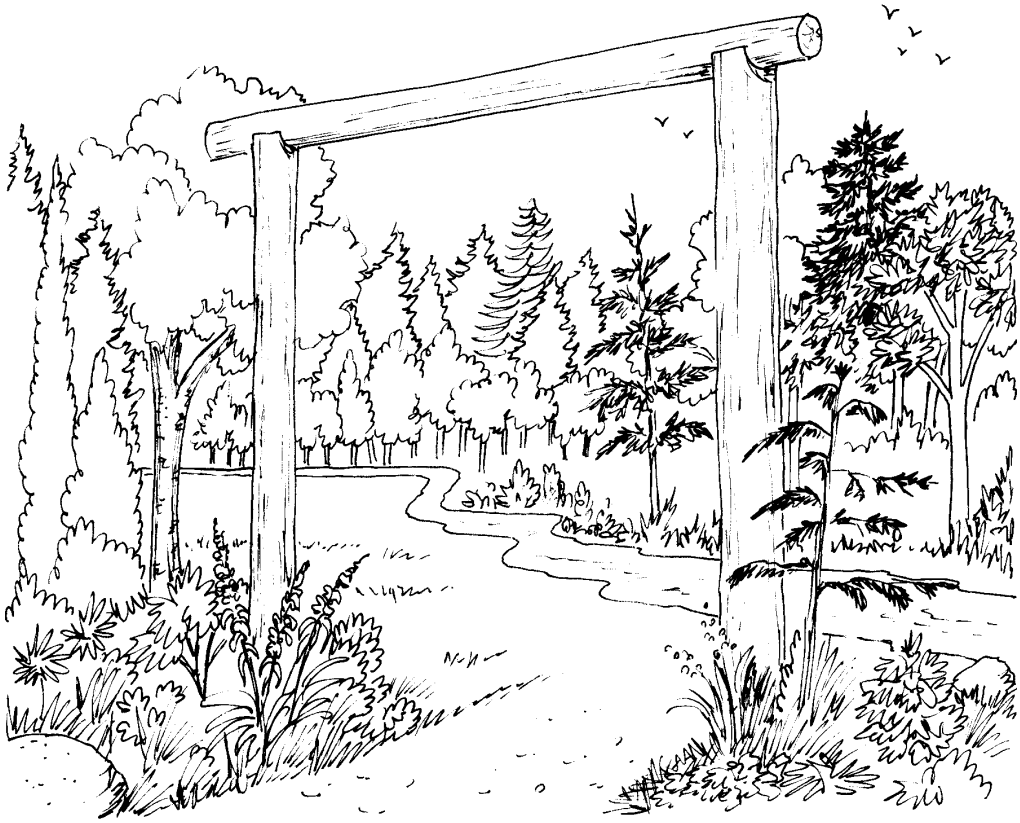
When your class arrives in Kananaskis Country, they will be directed to an open area away from the parking lot. They will be presented with a short orientation that will include:

- an orientation to the area and its history,
- an introduction to protected areas and a review of how to properly interact with a protected area,
- an introduction to the three ecosystems they will explore,
- introduction to the problem and basic guiding questions that are the focus of the field study,
- a review of the program activities that comprise the field study.

The actual field study activities are teacher directed experiences. At the conclusion of the orientation, teachers, parent volunteers and students will begin the field study activities.

"One year's atmospheric solar energy is the same as five hundred thousand billion barrels of oil or the same as eight hundred thousand billion tonnes of coal."

The Pollution Probe Foundation.
The Canadian Green Consumer Guide.



4.1.2 Scavenger Hunt With Questions

Objective:

The goal of this activity is to introduce the students to the study area as a whole and to actively introduce students to the three ecosystems they will visit during the field study. Students will develop an initial definition of each ecosystem. These definitions will be refined periodically throughout the day.

Students receive a list of items they must find. They then record information about where they found each item and some information about each item. They do NOT collect anything.

Time Required

45 minutes to complete the course,
15 minutes to discuss the answers.

Equipment provided by Kananaskis Country

thermometers

Equipment provided by the School

photocopies of the scavenger hunt sheets for each scientific team or pair of students.

Preparation

Photocopy a set of the scavenger hunt sheets (appendix D3) for each scientific team, or per pair of students, your choice. Speak to the students about the rationale behind not collecting things in a protected area.

Teacher Instructions

Gather the class together in a natural area that contains examples of grassland, boreal forest and aspen woodland ecosystems within a reasonable walking distance from each other. Have the students pair up, or work in their scientific teams.

After the instructions are complete, and before they venture out to complete the activity, meet individually with each scientific team to review:

- the instructions for the activity
- they know how to identify each ecosystem
- the time they should return to the parking lot.

Ensure that at least one student in the group has a watch.

"There are four laws of ecology:
1) Everything is connected to everything else.
2) Everything must go somewhere.
3) Nature knows best.
4) There is no such thing as a free lunch."

Barry Commoner

Start 1/3 of the group at question 1, 1/3 of the group at question 10 and 1/3 of the group at question 18.

Introduction

Indicate to the students that they have 45 minutes to complete as much of the scavenger hunt as possible. Remind them that unlike many scavenger hunts, during this scavenger hunt students must not collect anything. When they find evidence or the answer to a question, they should either draw a picture of it or describe it in the space provided. Note that each question is worth points.

Summary

Use the answer key (Appendix D3) to conduct a 15 minute class discussion to develop basic definitions of the three ecosystems they visited. Review any other key points that are relevant and reserve a full conversation about all the answers until you return to school.

Journal Entry

Ask, each student to record these initial ecosystem definitions in their Student Reflection Journals.

4.1.3 Ecosystem Explorations

Each ecosystem is explored using a consistent set of tests, observations, and data gathering. This serves as a control variable.

Once you arrive at a designated ecosystem discuss, with the students, where to place the tansect in order to produce a representative cross-section of the area. Lay out the transect according to this discussion.

Designate locations along the transect line for each scientific team to set up a 3 metre x 3 metre quadrat. Use the ecosystem card to complete the data collection and observations about that ecosystem.

This field study is intended to introduce students to the interactions and environments associated with three ecosystems.

Boreal Forest or Spruce Forest

The boreal forest region covers 35% of Canada. It consists of stands of white spruce, aspen and balsam poplar intermixed with bodies of water. Moisture is the dominant abiotic feature of this ecosystem. These ecosystems are home to an extensive range of wildlife that include moose, hare, lynx, weasel, wetland birds, wolves, beaver, ermine, woodland caribou and an abundance of birds and insects. This ecosystem comprises about 60% of Alberta's environment.

Grassland Ecosystem

Grasslands are typically flat plains or rolling hills punctuated by other remains of glacial retreat. They are warm, dry and windy. The soil is rich in top soil and has good drainage. They are populated by sun loving grasses (fescue, june grass, northern wheat grass, western porcupine grass, spear grass and blue gama to name a few), a wide variety of wildflowers and shrubs. The few trees (aspen) that grow in the grassland usually grow close together in groves.

Mixed Woodland Ecosystem

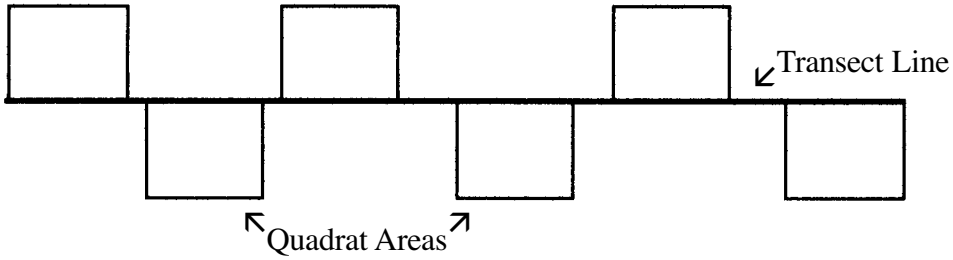
The mixed woodland ecosystem is primarily a deciduous forest. The dominant tree, balsam poplar, is intermixed with spruce and aspen poplar and a variety of shrubs including wild rose, saskatoon, willow and red oiser dogwood. The soil is rich and moist. A moderate amount of sun reaches the forest floor. Consequently, there is a variety of ground cover plants that include kinnikinnick, mosses and grasses.

What is A Transect?

For the purposes of this program, a transect is a 30 metre long cross section of any ecosystem. Transects are used in two ways. Scientists establish a transect to collect data on an ecosystem. Walking along a transect, scientists record data focused on specific attributes about the ecosystem that are observable within a 1 metre band along the transect line. Repeated monitoring along an established transect produces long term data on a cross section of the ecosystem. Scientists also use transects to delineate the cross section of an ecosystem that would then be used for a one time exploration using a quadrat.

What is A Quadrat?

Quadrats are square areas (usually 3 metre or 5 metres square) that are placed alternately along the transect line. Scientist record detailed and specific data about the area inside the quadrat that is used to understand population and diversity in the entire ecosystem.



4.1.4 Grassland Ecosystem Exploration (Generic)

Objective:

Using a toolkit filled with equipment and information, small groups will explore an ecosystem and collect data and evidence that is sufficient to describe and define that ecosystem. This teacher-led activity will lead the groups through a review lesson on how to monitor and collect data on an ecosystem using authentic field study methodologies.

Time Required:

30 - 45 minutes

Equipment provided by Kananskis Country:

- transect rope
- quadrat measuring tapes
- grid squares
- field guides
- 1 toolkit per scientific team containing all the required field study equipment and tools
- 1 teacher toolkit that contains additional equipment and materials not in the student kits

Equipment provided by the School:

- 1 copy of the ecosystem card for each each scientific team (Appendix C3)
- classroom created monitoring equipment
- classroom developed information about the ecosystems being explored (Journal contents)
- pencil
- coloured pencils
- clip board

Teacher Instructions:

Designate roles for each person in the group. (This should have been done in the preparatory activities):

- **curator,** prepares and labels artifacts gathered, keeps track of equipment
- **photographer,** takes pictures, video and records interviews of the days events
- **researcher,** organizes the collection of data into charts and graphs
- **zoologist,** collects and records qualitative and quantitative data on animal species
- **botanist,** collects and records qualitative and quantitative data on plant species
- **all students** are expected to enter data on the ecosystem cards.

Travel to the grasslands ecosystem.

Introduce the notion of transects and quadrats. Explain that each scientific team will want to collect accurate and specific data on this grassland ecosystem. Transects and quadrats need to be established that will allow the scientist to collect reliable data that will produce an accurate definition of this ecosystem and enable generalizations about its relative health.

Discuss where to locate the transect and set out the rope. Assign each scientific team to a portion of the transect and set up the quadrats.

Distribute the **Ecosystem Toolkit** to each scientific team. Inventory the contents of each toolkit and review how to properly use the equipment to gain optimal results and reduce breakage.

Systematically lead all the groups through collecting the required data, as outlined on the **Ecosystem Cards.**

Be sure to discuss and complete the following items off the **Ecosystem Card.** The objective of this teacher-led grasslands exploration is to prepare each group to be able to conduct all these tests, on their own in the afternoon, when they visit and gather data on the aspen woodland and boreal forest ecosystems.

Ecosystem Card Components: Curator

Complete masthead information: Record data about the ecosystem, date, weather, etc.
Scale drawing of entire transect: Use the clinometre to draw a scale cross section profile, that demonstrates the height variance of objects along the transect.
Other: Record data on the ecosystem card as it is collected.

Photographer

Slope: Use the clinometre to determine the angle of the slope for the entire transect line.
Aspect: Use a compass to determine the direction that your transect and quadrat faces.
List of equipment and materials used.
Other: Complete colourful rubbings of items in the areas being explored. Record the entire event with photographs, slides or video.

Researcher

Temperature: Use air and soil ord temperatures 1 metre above ground, at ground level and below ground level within the quadrat.

Zoologist

Wind: Make observations about wind strength and the factors that influence the impact of wind within the quadrat area.
Evidence of biotic features: Collect data on observations about biotic features in the quadrat area such as animal browse markings, nests, burrows, tracks, scat, animal trails, scratch marks on trees or logs, etc.

Botanist

Soil profile: Use ct soil and diagram a cross section of the soil within the quadrat.
Soil compaction: Determine if the soil has a high, medium or low degree of compaction ability within the quadrat.
Soil moisture: Determine if the moisture level of the soil is high, medium or low within the quadrat area.
Soil pH: Use pH paper, pH pens or pH testing kits to determine the pH of the soil at various places within the quadrat area.

Everyone is expected to make contributions about the following:

Detail of area in quadrat, including plant identification and populations: Draw an accurate scale diagram of the interior of the quadrat area. This should reflect consideration of all the criteria mentioned in this list.

Evidence of human impact: Record observations about the impact that humans have had on the overall area. Not just in the present, but make reflections about obvious historical uses by looking around for evidence of human activity.

Aesthetic features: Describe the aspects of the quadrat area that are appealing to humans. These are features that make this ecosystem unique from all others, and that people enjoy when in this ecosystem. These could be wildflowers or unique plants, colourful leaves, unique animal features, sounds, smells, etc.

List any unique observations.

List the land uses that are present: Generate a list of land uses you observe in the area.

Summary

Once they have completed collecting and reviewing the data on the grasslands ecosystem and gathered up all their equipment, ask them to re-visit their initial definition of a grassland ecosystem developed after the score orienteering activity. Does it need to be revised as a result of this in-depth look?

4.1.5 Summary Discussion and Student Reflection Journal Entry

Objective:

To summarize the mornings activities and review concepts.

Time Required:

15 minutes

Equipment provided by the Centre:

None

Equipment provided by the School:

Student Reflection Journals
Pencils

Teacher Instruction:

As an entire class, ask the students to reflect on, and answer as many of the following questions as time and interest allows. This could also be done in small groups, or by having similar roles from each group get together to share data. A summary should be recorded in their Student Reflection Journals.

1. What characteristics define and describe this ecosystem?
2. What influences interact here to create this unique ecosystem?
3. What land uses did you notice?
4. What evidence of human use and interaction with this ecosystem did you find?
5. Which of these human uses and interactions have been positive and which have been negative?
6. What issues threaten the health and sustainability of this ecosystem?
7. What aesthetic features about this ecosystem do you value and why?
8. What is the most interesting aspect of this ecosystem to you?
9. What actions could you take to sustain or improve the health of these ecosystems?
10. What would you do to protect this area?

Students should leave this part of the field study with all the "evidence" they will need to define, describe and explore this ecosystem, and its various types of land use, at a later date.

4.2 Lunch
(30 minutes)

Before you visit Kananaskis Country discuss the idea of garbage free lunches with your students.

Garbage free lunches consist of food containers that can be re-used. The objective is to maximize the life of these containers before they are disposed of. By reducing before recycling, it's possible to reduce consumption of the natural resources used to produce excess packaging. By recycling afterwards, not only is consumption reduced, but these natural resources are also recycled.

Consider the following when putting together a garbage free lunch.

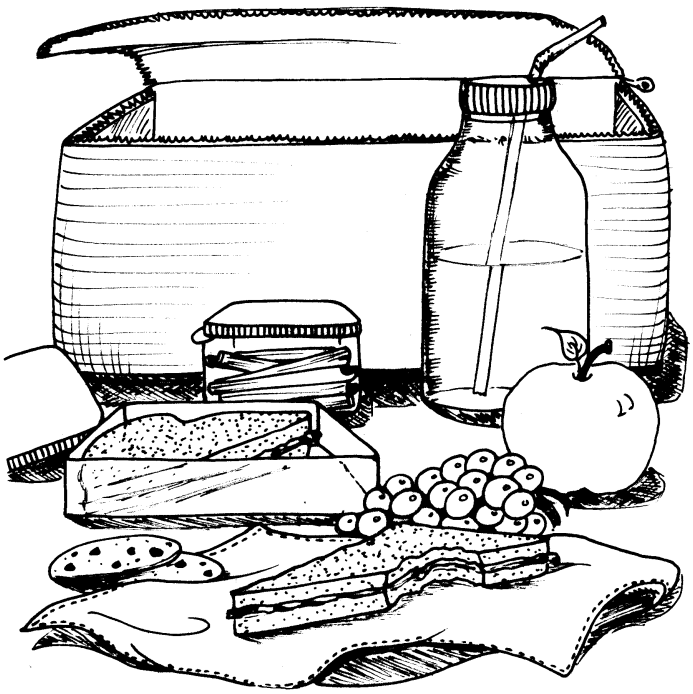
- Cloth bags or lunch boxes should be used instead of paper of plastic bags.
- Re-sealable plastic bags or hard plastic re-sealable containers are preferable to plastic wrap or wax paper.

If possibe, 'one-time disposable snacks' should be avoided. Instead snacks could be packaged in re-usuable containers. Re-sealable glass jars are better alternatives for drinks than drink boxes, aluminium cans or milk containers, even though many of these are recyclable. Remember recycling services are not available everywhere. Even if an item is recycable, if facilities for recycling that item are not available in your community, it should be considered as non-recylable.

"Those who contemplate the beauty of the Earth find reserves of strength that will endure as long as life itself. There is a symbolic, as well as actual beauty, in the migration of birds, the ebb and flow of tides, the folded bud ready for spring. There is something infinitely healing in the repeated refrains of nature."

Rachel Carson
in Silent Spring

Be sure to pack out everything you you pack in. Remember the only evidence you should leave behind are a few carefully placed footsteps.



4.3 Afternoon Program

Revisit the projects section and remind students about why they are collecting this data. Remind them to be sure they have all the data they need to complete their various projects back at school.

4.3.1 Detailed Exploration of Two Other Ecosystems

"By the year 2000 it is expected that half the world's tropical forest will have been razed to supply the timber trade and make room for agriculture."

The Pollution Probe Foundation.
The Canadian Green Consumer Guide. (1989)

Objective:

To provide an opportunity for an in-depth exploration, similar to the one conducted in the morning, of a boreal forest and aspen woodland ecosystem.

Time Required:

60 - 90 minutes to consecutively explore each ecosystem.

Equipment provided by Kananaskis Country:

same as with grasslands ecosystem exploration

Equipment provided by the School:

same as with grasslands ecosystem exploration

Teacher Instructions:

Travel to the Aspen Woodland ecosystem and the Boreal Forest ecosystem. Each group will repeat the **Ecosystem Exploration** they did in 4.1.5 in these two different ecosystem. Remind all scientific teams that they will be required to share their information with the entire class when they return to school.

4.3.2 Protected Areas Role-Play Active Game

Objective:

An active role playing activity that involves decision making, use of the information students acquired throughout the day while providing a vehicle to discuss protected areas, land use patterns and ecological health.

Time Required:

45 minutes

Equipment provided by Kananskis Country:

4 plastic bins containing all the materials required to play the game.

Equipment provided by the School:

Student Reflection Journals
Pencil

Teacher Instructions:

Setting up the Game:

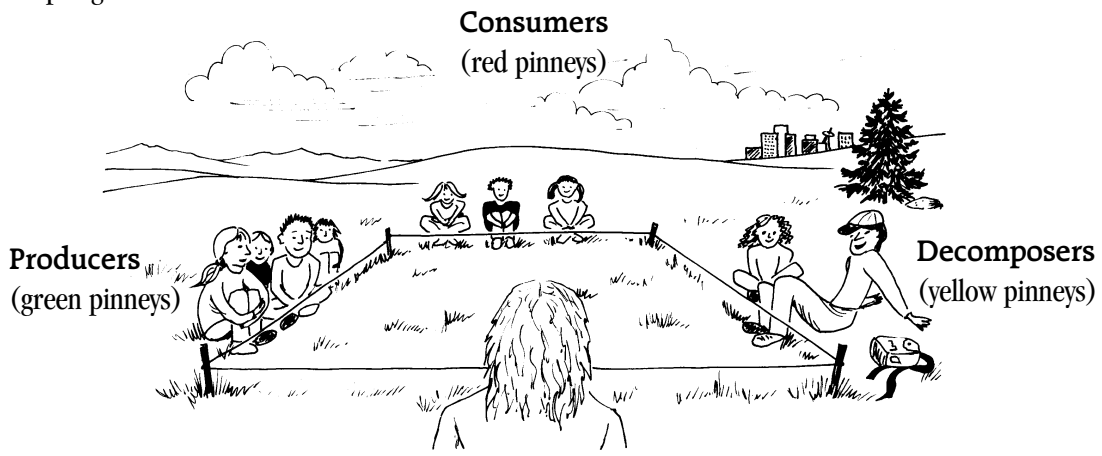
Delineate the playing area 10 metres by 10 metres (per class of 30 students) using the white rope on the spool and tent pegs. The rope is marked at 10 metre intervals with a black band. The tent pegs hold the corners in place. Place 8 basic needs stations (there are 12 in total) randomly within the playing area. These containers are full of small pieces of paper that represent the basic needs of food, water, shelter, space and offspring.

Each station should contain at least 50 coloured tags. Divide the class equally into three groups of producers (green pinneys), consumers (red pinneys) and decomposers (yellow pinneys). Place each group on one side of the square while the teacher stands on the other. Ask each student to put on a T shirt from their green container.

Round One:

How to play:

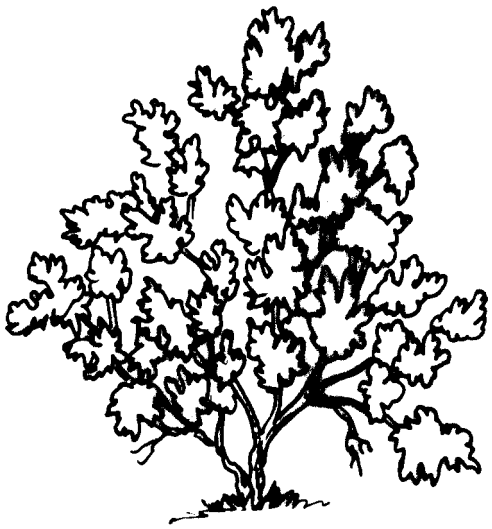
Explain to the class that the area inside the rope is a protected wilderness area that has just been made available for development. This is a multiple round game and the object for you, the flora and fauna, is to meet your "basic needs" in order to survive, while a variety of land uses take hold in the wilderness protected area you live in. Each round will offer new challenges by incorporating land uses and environmental issues that arose throughout the field study.



On the teacher's command, everyone will enter the playing area to collect tags from each of the stations and other plants and animals. The objective is to survive as a group, not as individuals. After each round, each group will pool their coloured tags and count how many complete sets of five different coloured tags their entire group has collected.

This number represents their survival rate (how they satisfied their basic needs) under the conditions from that round. The coloured tags are returned to the basic needs stations within the playing area after each round.

Producers
Shrub

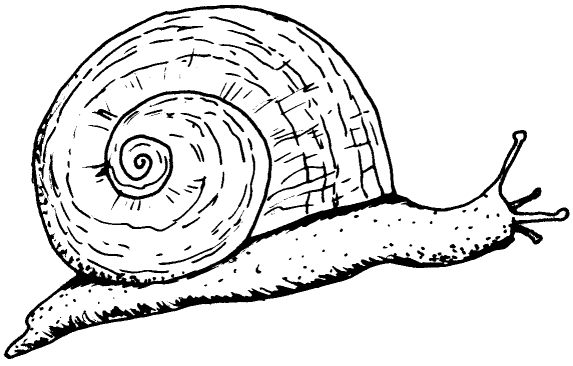


Living organisms, such as plants, that are able to produce their own food through photosynthesis.

Consumers
Snake

Living organisms that gain the energy they need to survive by consuming other living organisms. Consumers that eat plants are called herbivores. Consumers that eat meat are called carnivores. Consumers that eat both plants and meat are called omnivores. Consumers are not able to produce their own food.

Decomposers
Snail



Living organisms that get the energy they need to survive by consuming dead and decaying plant and animal material.

Explain the rules for collecting basic needs tags:

Producers: The students who are playing as producers must meet their basic needs for survival by collecting tags from the basic needs stations. They are the only players who may collect tags from the basic needs stations. They may collect one tag from one station per visit. They can return to the stations as much as time will allow, regardless of how many times they are caught by a consumer. They cannot visit the same station twice in a row.

Consumers: The students who are playing as consumers must meet their basic needs for survival by catching (tagging) a producer and collecting one tag from that person. You can collect only one tag from one person per interaction. Consumers cannot tag the same producer twice in a row.

Decomposers: The students who are playing as decomposers must meet their basic needs for survival by catching (tagging) a producer or a consumer and collecting one tag from that person. You can collect only one tag from one person per interaction. Decomposers cannot tag the same producer or consumer twice in a row.

Ask the producers to enter the playing area first. Let the consumers enter the playing area 30 seconds later. After another 30 seconds let the decomposers enter the playing area. Let the game progress with all students interacting in the playing area for 2 minutes. Stop the game, send them back to their home bases to pool and count their basic needs tags and determine their survival rate for that round. (Remember they need complete sets of any 5 different colours to count for one species survival).

After each round discuss the following questions:

- What challenges did they face?
- How did they feel while in the protected area?
- Review how many species survived (must have collected all the required basic needs tags).
- How has the relative health of this protected area been threatened by the events presented in this round?
- What is the survival rate (did everyone get the requirements they need to survive?) for each of the producer, consumer and decomposer groups?
- Ask each group of students to remember their survival rate and compare them across all the rounds in the game.

Return the basic needs cards back to the stations in the playing area.

Round Two:

Introduce human land uses such as a small town and roads. Discuss where they wish to locate the town. Place the blue tarp into the protected area at the location they select. It's should cover 1 basic needs station. This station can no longer be used.

Explain that the town must have road access to all sides of the playing area.

Discuss how they wish to arrange the roads, and place the white ropes on the ground according to this conversation.
Replay the game as in round one,
with the additional rules:

- Nobody goes into or over the town.
- Consumers and decomposers can only cross the roads at designated wildlife overpasses and underpasses and defined by the black sections in the rope roads. Producer can cross the roads anywhere they like.

If anyone breaks these additional rules they are "dead". Dead species no longer play that round of the game and must sit beside the teacher in the "cemetary". They may return for the next round.

Discuss the same questions as in Round One.

Round Three:

Introduce a land use such as a wilderness reserve.

Discuss where they wish to place a concentrated number of additional basic needs stations within the protected area. Place another 4 basic needs stations in the playing area according to the conversation.

Play the game as in round two obeying the rules introduced in the previous rounds.

Discuss the same questions as in round one.

Round Four:

Introduce a land use such as resource extraction. This could be an ore mine, oilfield or timber removal project for example.

Discuss where they wish to place this project. Place the green tarp at this location. Rearange the roads so they provide access to the town, the resource extraction site and all four sides of the playing area. Don't move any of the basic needs stations or the townsite.

Play the game according to the following rules:

- Nobody goes into or over the town.
- Nobody goes into or over the resource extraction site
- Consumers and decomposers can only cross the roads at designated wildlife overpasses and underpasses and defined by the black sections in the rope roads.
- Producer can cross the roads anywhere they like.

Round Five: Challenge Round:

Arranging the land uses within the protected area to maximize survival for all natural species while allowing human land use and development.

By this point most species will have trouble surviving. Discuss the following:

Most areas have dozens of land uses. We have introduced only 4 and we are experiencing difficulty in surviving. Tell the students that they are the managers of this protected area and it's their responsibility to develop a plan that will provide for maximum survival of the natural flora and fauna species while allowing all the present human land uses and development to exist. Challenge each group of producers, consumers and decomposers to come up with a plan for re-arranging all the items within the protected area to accomplish this goal.

Give the groups 2 minutes to decide on a strategy. Discuss each of these strategies as an entire group. Re-arrange all the items in the protected area according to this conversation.

Play the game again, according to the rules established in round 5 and discuss the following:

- What challenges did they face?
- How did they feel while in the protected area?
- Review how many species survived (must have collected all the required basic needs tags).
- How have the survival rates of natural flora and fauna changed as a result of your changes?
- What additional changes would you make to improve the ecological health of this protected area while still allowing human land use and development?

Clean Up

Gather all the props and materials and place them back into the green containers.

4.3.3 Student Reflection Journal Entry

Objective:

To summarize the afternoon activities.

Time Required:

15 minutes

Equipment provided by Kananaskis Country:

none

Equipment provided by the School:

Student Reflection Journals
Pencils

Teacher Instructions:

In their Student Reflection Journals ask each student to graphically design and describe a protected area that includes:

- an area of 50 square kilometres,
- 3 different ecosystems,
- a small town with a population of 1,000 people,
- 5 additional land uses beyond those the town creates, such as greenspaces, industry, airports, trainlines, roads in and out of the town, campgrounds, trails, and any other land uses they observed during the field study that will allow everything, including the sustainability of the ecosystems involved, to co-exist.

4.4 Travel Back To School

At the completion of the day's field study activities:

- Return to the parking lot. Answer any questions there might be.
- Inventory and return all equipment to the Learning Centre.
- Board the bus.

"If the Earth
were only a few feet in diameter, floating
above a field somewhere, people would come from
everywhere to marvel at it. People would walk around it
marveling at its big pools of water, its little pools and the water
flowing between. People would marvel at the bumps on it and the
holes in it. They would marvel at the thin layer of gas surrounding it
and the water suspended in the gas. The people would marvel at all the
creatures walking around on the surface of the ball and at the creatures in
the water. The people would declare it as sacred because it was the only
one, and they would protect it so that it would not be hurt. The ball
would be the greatest wonder ever known, and people would come to
pray to it, to be healed, to gain knowledge, to know beauty and to
wonder how it could be. People would love it and defend it with
their lives because they would somehow know that their lives
could be nothing without it. If the Earth were only
a few feet in diameter."

Joe Miller

The "Nature" of Science

5.0 Post Field Study Activities

5.0 Post Field Study Activities

Completing effective follow-up activities is crucial to consolidating the learning associated with this field study while turning this knowledge into an effective action that improves the environment. Once the projects and activities are complete please share the data, interpretations and recommendations with other schools, local environmental groups and Alberta Environment, the local MLA, and local municipal governments.

The projects (both group and the entire class) suggested in this section have been developed in such a way that they provide a structure for students to record data, observations and reflections throughout the experience, not just after the field study. You are welcome to develop your own projects and activities, beyond the ones described in this package.
The intent of the follow-up activities and projects is for students to develop answers to the original scenario (Section 1.5).

You as a member of a five person science team, have been contracted to make recommendations about how to protect three ecosystems, you will visit during a field study, from potential environmental damage while still allowing them to be "used" by humans.

Alberta has a variety of protection levels within its protected areas legislation. The level of protection varies according to a wide variety of criteria. The extent or degree of protection is represented in the measure and type of land use permitted from one protected area to another. Throughout this field study experience, students will explore three different ecosystems. According to the criteria students develop for determining the level of protection an area should receive, and what they discover about each of the ecosystems they visit, they will be asked to make recommendations, as a scientific team, about what types and levels of land use should be permitted in each ecosystem they visit, in order to maintain the long term health of each ecosystem.

Some of the following guiding questions could be answered in their projects or class activities.

- Definitions of each of the ecosystems visited on the field study?
- Examples of food chains and food webs from each of the ecosystems.
- What factors influence and interact to create different ecosystems?
- What is a protected area?
- What criteria should be used to decide on the level of protection an area should receive?
- What land uses should be allowed to occur in the three ecosystems they visited on the field study so that the health of the ecosystem is maintained?
- To what level should these uses be permitted to threaten the protected area?
- What impact do these uses have on the long term health of the ecosystem?
- How does natural biodiversity influence how an area should be protected?
- How does population influence how an area should be protected?
- How do aesthetic features influence how an area should be protected?
- What land uses did you discover? Was the impact of these land uses positive or negative?
- What human activities, or land uses, threaten the sustainability of these ecosystems?
- What actions could be undertaken by individuals, governments, business and you to ensure that laws about protected areas are followed?

5.1 Connecting Ecosystems

Objective:

To provide an opportunity for all students to share, compare and gather additional data about the ecosystems they explored on the field study. This activity is particularly important if the students only had time to explore two of the three ecosystems. Students should use this opportunity to gather data about the ecosystem they did not explore on the field study.

Time Required:

45 - 60 minutes

Teacher Preparation:

Photocopy the student instructions for this activity (Appendix E1). Gather together pieces of large chart paper and all resource materials.

Teacher Instructions:

1. Introduce the activity instructions (Appendix E1) and set up work stations with large sheets of chart paper (approximately 1 m x 1 m).
2. Distribute copies of the student instruction sheet. (Appendix E1.1)
3. Designate one of the ecosystems explored on the field study for each group.
4. Instruct the students to follow the instructions on the students instruction sheet.
5. After about 15 minutes, ask the groups to rotate to a different ecosystem chart paper and continue the process from where the previous group left off.
6. Continue to rotate groups until every group has visited all the stations.

The objective is for each group to visit all the work stations and add any information they have, that is NOT on the chart paper already. In addition, they should also add to their notes, anything that is on the chart paper, that they do NOT have in their notes. This will result in every student having an extensive collection of observations, measurements, notes and information about the three ecosystems visited on the field study.

5.1.1 Summary Discussion

Objective:

To review and summarize the information gathered during the score orienteering and/or scavenger hunt activities.

Time Required:

30 minutes

Teacher Instructions:

Conduct a class discussion that reviews and summarizes the answers students gathered during the score orienteering activity and the scavenger hunt.

"Climb into the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy, while care will drop off like autumn leaves."

John Muir

5.2 Student Group Projects

5.2.1 Group Lab Report Project

This project forms the basis for many of the other small group projects and full class activities. Completing this project provides an individual tool for teachers to evaluate students work, while providing each students with the necessary resources to be an active and contributing member of the efforts of the group toward completing their group project. A student lab report guideline sheet that describes the expectations for group projects is included in Appendix E2.

The content of the Lab Reports should contain:

- a description of the problem,
- their prediction(s) of possible solutions,
- a description of the scientific process they followed,
- detailed observations from the field study,
- interpretation and analysis of their observations,
- recommendations, that are directed at the scenario and guiding questions (1.5), about what they would suggest be done to protect the ecosystems they visited on the field study,
- graphs, graphics and pictorial data that support their lab report recommendations,
- answers to the questions suggested above and in the problem described in section 1.5,
- a complete Student Reflection Journal from each group member.

5.2.2 PowerPoint Computer Presentation

Use PowerPoint, or a similar computer software package, to place the content of the lab report (5.2.1) onto a computer program that could presented to the class. A digital camera and tape recorder could be used to collect photographs and comments, that could be include in this presentation. These could be exchanged with other classes and schools who participate in the program.

5.2.3 Slide/Tape Presentation

Throughout the entire experience the students would be expected to take slides, conduct taped interviews, select appropriate music as a background soundtrack and gather resources from the media, magazines, printed resource materials and the internet, for example. These would all be assembled into a slide / tape presentation that summarized the content of the lab report expectations (5.2.1). These could be exchanged with other classes and schools who participate in the program.

5.2.4 Video Presentation

Throughout the entire experience the students would be expected to record video footage, conduct taped interviews, select appropriate music as a background soundtrack and gather resources from the media, magazines, printed resource materials and the internet, for example. These would all be assembled into a video presentation that summarized the lab report expectations (5.2.1). These could be exchanged with other classes and schools who participate in the program.

5.2.5 Dramatic Presentation

Groups of students would develop a dramatic presentation to represent the lab report expectations (5.2.1). These could be video taped and exchanged with other classes and schools who participate in the program.

5.2.6 Community In A Creative Container

In addition to the content expected in the Lab Reports, the group would develop a creative container, for each of the ecosystems, that contained a variety of items that sufficiently defined and described the communities or ecosystems they explored while summarizing the lab report expectations (5.2.1).
The creative container might contain:

- photographs
- artwork
- items collected from the area (provided their removal does not present a concern)
- models
- dioramas
- posters
- video tapes

These could be exchanged with other classes and schools who participate in the program.

5.2.7 Ecosystem Puzzles

Make a large blank puzzle template (at least 1 m x 2 m) using foam-core, cardboard of thin plywood. On one side of the puzzle could be a detailed colourful picture of the ecosystem the group was representing. On the other side would be a black and white line drawing of this same picture. On top of this line drawing would be additional pictures, information and material that summarized the lab report expectations (5.2.1).

"The major problems in the world are the result of the difference between the way nature works and the way man thinks."

Gregory Bateson

5.2.8 Large Interactive 3-D Puzzles

Groups of students would create a large 3 dimensional object, (approximately 1 cubic metre) that could be constructed out of foam-core, cardboard or light plywood. Using a board game format and a series of clues and creative questioning strategies, the challenge would be to assemble the 3 dimensional puzzle by successfully answering questions that summarized the lab report expectations (5.2.1). These could be exchanged with other classes and schools who participate in the program.

5.2.9 Public Education Program

The group would develop a public education program that would be used to educate about the ecosystems they visited and how to protect them while summarizing the lab report expectations (5.2.1). This could take the form of a magazine, poster or pamphlet, for example.

5.2.10 3-Dimensional Interactive Book

The group would create a large interactive book that summarized the lab report expectations (5.2.1).
The books might contain:

- flaps,
- wheels,
- windows,
- pop-ups,
- items collected from the area (provided there removal does not present a concern),
- a variety of mediums in the construction,

These could be exchanged with other classes and schools who participate in the program.

5.2.11 Urban Planning and The role of Protected Areas

The student group could approach the local municipal government to acquire a copy of the planning document that outlines the municipalities long term development plans. Using the questions and criteria expected in their lab report (5.2.1), explore how the municipality plans for both ecological and human sustainability in future development plans. How are protected areas, greenspaces, the needs of people, concern for the environment and available financial resources a factor in municipal planning? This could result in a written report being submitted to City Hall, or students making a presentation to City Council.

5.2.12 Website Development and Maintenance

The Global Environmental and Outdoor Education Council (GEOEC) of the Alberta Teachers' Association operates a World Wide Web internet site (**http:www.rockies.ca/eoec**). Groups of students could both develop and maintain this site on a regular basis. Schools that participate in the "Nature" of Science program across Alberta would submit their field data and special projects to this site. Everyone across the province could have access to this information.

5.2.13 Environmental Magazine

"This is a present from a small distant world. We are attempting to survive our times so that we may live into yours."

Recorded message on board the Voyageur space probe

A group of students would develop an environmental magazine. Each student in the group would write a reflective article, in a magazine style, that summarized some aspect of the lab report expectations (5.2.1). The creatively titled collection could be circulated to other schools, sent to GREEN TEACHER magazine, the Global Environmental and Outdoor Education Council (GEOEC), or to other similar organizations, for inclusion in their publications.

5.2.14 Access In A Protected Area

A group of students would create a 3-D model or top view diagram of their ecosystem(s). Then, by summarizing the lab report expectations (5.2.1), they would designate the areas most in need or protection and show how they would protect these ecosystems into the future.

5.3 Post Activities For The Entire Class

If you are choosing to not do projects, there are a number of other possibilities for students to synthesize and use the data collected on the field study. First consider the projects that are outlined in section 5.2. Many of these lend themselves to classroom follow up work as activities or in-class lessons. Beyond this the following describes some other activities.

5.3.1 Individual Lab Report Project

"It's so incredibly impressive when you look back at our planet from out there in space and you realize so forcibly that it is a closed system - that we don't have any unlimited resources, that there's only so much air and so much water."

Edgar Dean Mitchell,

This project forms the basis for many of the other small group projects and full class activities. Completing this project provides an individual tool for teachers to evaluate students work, while providing each students with the necessary resources to be an active and contributing member of the efforts of the group toward completing their group project. A student "criteria sheet" that describes the expectations for group projects is included in Appendix E2. The content of the Lab Reports should contain:

- a description of the problem,
- their prediction(s) of possible solutions,
- a description of the scientific process they followed,
- detailed observations from the field study,
- interpretation and analysis of their observations,
- recommendations, that are directed at the scenario and guiding questions (1.5), about what they would suggest be done to protect the ecosystems they visited on the field study,
- graphs, graphics and pictorial data that support their lab report recommendations,
- answers to the questions suggested above and in the problem described in section 1.5,
- a complete Student Reflection Journal from each group member.

5.3.2 Unknown Species

Objective:

The students use the data and knowledge they have acquired throughout this field study experience to identify "mystery" species and the ecosystems they live in.

Time Requirements:

45 - 60 minutes

Teacher Preparation:

Prepare photocopies of:

1. "Unknown Species Card" (Appendix E3) These 11 cards contain information about a variety of plant and animal species that live in Alberta.
2. "Unknown Species 1" (Appendix E4) This is an answer sheet for students to fill out as they explore the prepared unknown species cards.
3. "Unknown Species" (Appendix E5) These are blank unknown species cards for student to complete and share with classmates.
4. "Unknown Species Ecosystem Web" (Appendix E6) These are blank unknown species cards that have been organized into a food web for students to complete and use to demonstrate inter-relationships.

Teacher Instructions:

A biologist has indicated that these species are looking for a suitable habitat (ecosystem) to live in, but the biologists have forgotten to give us the names of the species. Instead, all we have is some information about the survival requirements of each. Can you identify the species, indicate the ecosystem they would best survive in and describe the role they play in the ecosystem?

Part 1:

1. Ask the students to gather together all the data they have developed throughout the field study to date. This will serve as resource material for this activity. Add any school based reference books, field guides and support material that is available.
2. Circulate copies of the "Unknown Species Cards" (Appendix E3). These contain information about a variety of species, but the name of the species is missing.
3. Ask the students to use what they have learned to determine the name of the unknown species and the ecosystem they would live in.
4. Use the "Unknown Species: Who Am I?" (Appendix E4) worksheet to record their answers.

Unknown Species:

For PART 1 "Unknown Species Cards" have been developed for the following:

- Species common to all three ecosystems: Mule Deer and wild Prickly Rose
- Species more common to Aspen Parkland: Saw-whet Owl and Goldenrod
- Species more common to Grassland: Creeping Juniper and Garter Snake
- Species more common to the Boreal Forest: Sphagnum Moss and Mink

Displaced Species

Three additional Unknown Species Cards have been developed for the Timber Wolf, Grizzly Bear and Wolverine. At one time these species lived in the ecosystems visited on the field study, but for a variety of reasons, they no longer can be found there.

Conduct a class discussion to address the following questions about displaced species.

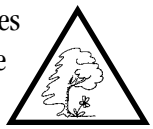
- Why do these species no longer live in these ecosystems?
- If these species were re-introduced into these ecosystems tomorrow, would they survive?
- What would need to change in order to allow them to be re-introduced and survive?

Part 2:

1. Circulate copies of the blank "Unknown Species Cards" (Appendix E5) and ask the students to use what they have learned, and the resource materials available, to fill in all the information they can about an "Unknown Species" of their choosing.
2. Circulate these student generated "Unknown Species Cards" amongst the class and challenge other students to determine the name of the unknown species and the ecosystem they live in.
3. Students can record their answers on the worksheet entitled "Unknown Species: Who Am I" (Appendix E4)

Part 3:

1. Circulate copies of the "Unknown Species Ecosystem Web" (Appendix E6.1). Ask the students to designate 2 producers, 2 consumers and 2 decomposers from one of the ecosystems they explored on the field study. A list of some of the plants and animals of Alberta's natural regions is attached in appendix E7.
2. Complete an "Unknown Species Card" for each of the members in the "Unknown Species Ecosystem Web" they have created. BE SURE TO LEAVE THE NAMES OF THE SPECIES OFF EACH CARD.
3. Circulate these "Unknown Species Ecosystem Web" sheets that have been generated by students, randomly to other students in the classroom. Instruct the students to use the research information and their field study data to determine the name of each of the unknown species in their web, identify the ecosystem and draw lines that connect these species indicating how how these species are inter-related in the natural world. The result is a partial food web.



"Nobody made a greater mistake than he who did nothing because he could only do a little."

Edmund Burke

Conclusion

Discuss what the students have determined the unknown species to be. Discuss the significance of each, relative to the ecosystems the students explored. For example:

1. Did they correctly identify the unknown species?
2. Did they place them in ecosystems that they could survive in?
3. Why are some species not there any more?
4. How has human use of the area influenced their presence and population
5. What would happen in the species was re- introduced to that area?
6. Why do some species only live in particular areas?
7. What specialization and adaptations do species have?
8. How do these adaptations differ across ecosystems?

5.3.3 Local Stewardship of A "Protected Area"

Objective

The goal of this activity is to select a local area that could be "protected" through the actions of students.

Time Required

Varies with level of activity.

Preparation

Select a local area that could be considered for stewardship activities (such as naturalization), that result in protection from present and future land-uses that could compromise the health of existing ecosystems.

Teacher Instructions

Using local resources (financial grants, human resources, corporate support, local landscapes, garden clubs, etc.), and the knowledge acquired through this field study experience, develop a plan to "protect" this area.

Select a local natural area and develop a plan that will:

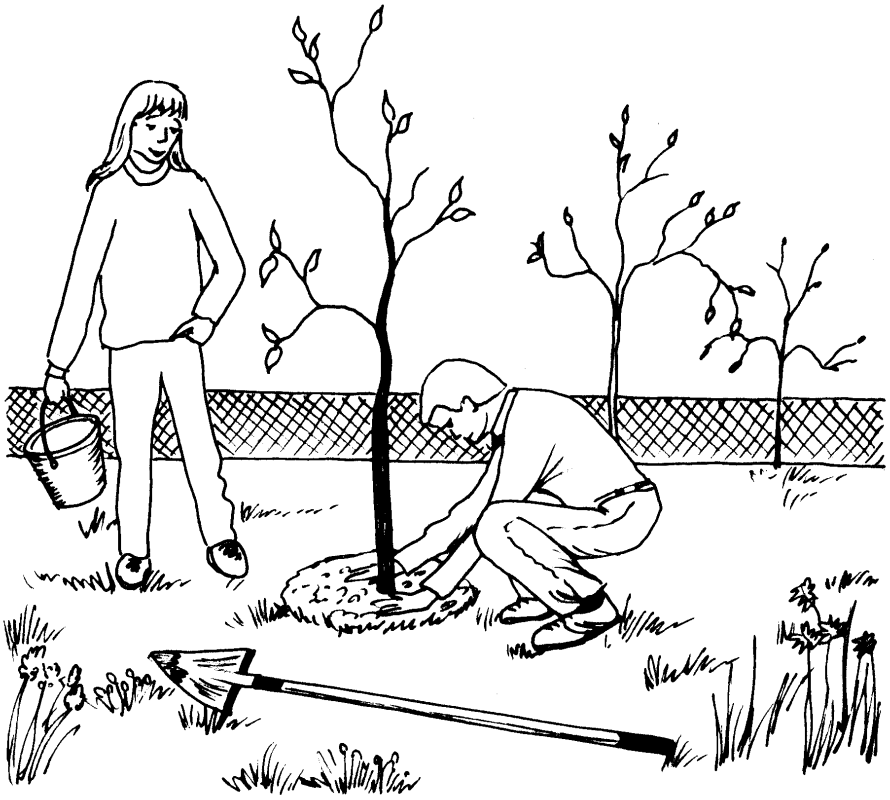
- sustain the ecological health of existing ecosystems,
- add to its natural biodiversity by "naturalizing" the area with native plants and removing species that don't belong there.
- educate about how to interact with the area in a manner that will not damage it,
- create an outdoor classroom that other students and members of the community could use,
- develop self-guided interpretative walks that are accessible to the public.

"Before we can teach children, we have to give them a reason for learning; the reason being to become part of the world; thinking of it together rather than in pieces."

Aldo Leopold

Schools in the Calgary area that are interested in this activity should contact the Horticultural Programmer at the Calgary Zoo (403 - 232-9335) or the Fish Creek Environmental Learning Centre (403 - 297-7927 or 297-7827) for support and direction.

Schools interested in conducting this activity in Kananaskis Country should contact The Friends of Kananaskis Country, volunteer trail care group. Phone 403-678-5508



5.3.4 Protected Areas Debate

Objective

The goal of this activity is to conduct full class debates on relevant issues or topics.

Time Required

45 - 60 minutes of classtime. Most of the student preparation could happen on their own time.

Preparation

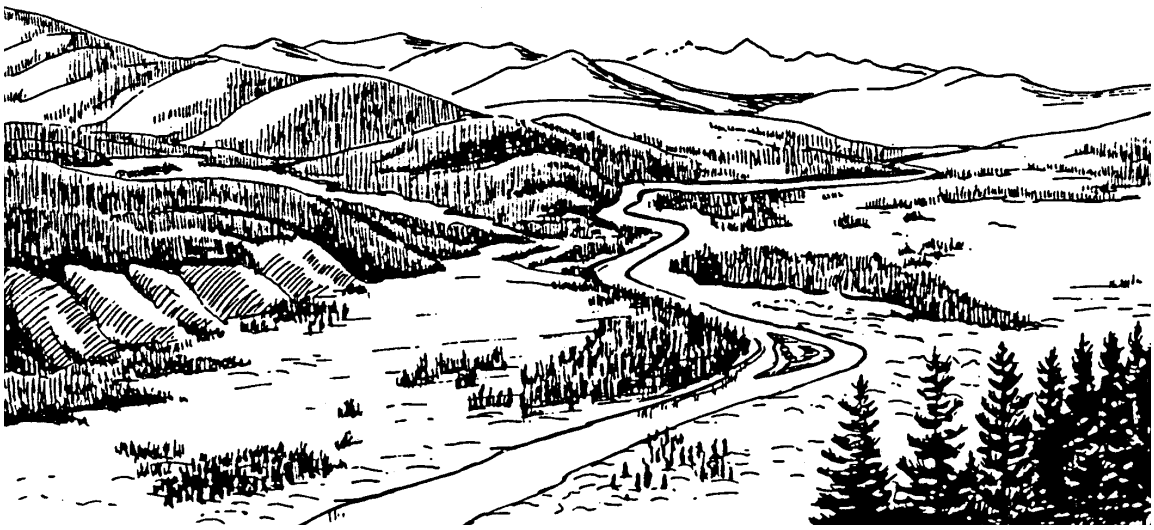
Select between 2 and 4 issues that are relevant and of interest to students. These issues could be ones that emerge through student interest, are topical in the media, or are on-going concerns in your community. Develop a scenario around each issue to present to the debating teams and the entire class. Don't tell the class which issue they will debate. Instead, have each group prepare for all issues.

Select a group of parents to serve as judges. Designate time lines for preparation and debates.

Teacher Instructions

In preparation for conducting an all class debate, instruct each student to complete a lab report (5.2.1) and prepare to debate an issue.

1. Organize the classroom into teams comprised of the research groups used during the field study. Introduce the issues that have been selected and explain that each team must prepare to debate each issue. They will not know the issues they are to debate until a few minutes before the debate begins.
2. Review the rules for a classical debate.
3. Provide some class time to get organized. Leave the remainder of the preparation for each group to do on their own time.
4. On the date of the debate, introduce the judges, select 2 teams to debate, introduce the scenario and issue, give each group a few minutes for final preparation and begin the debate.
5. Throughout the debate the teacher should serve as moderator.
6. At the conclusion of the debate ask the judges panel to select a winner and support their decision. Conclude the debate with a class discussion.



possible debate issues:

- Are protected areas essential to the survival of ecological sustainability?
- Does science provide all the answers decision makers require to determine the level of protection an area should receive?
- Should the citizens of Alberta be permitted to visit any crown lands in Alberta and engage in any activities they deem to be appropriate?
- Should the hunting of endangered species should be permitted in areas where their populations are strong?
- Are some ecosystems more important than others, and therefore should be protected ahead of other ecosystems?
- Do humans, as the primary consumer species on the planet, have the right to do whatever they want, anywhere they want, because they are intelligent enough to solve any problems or concerns that arise?
- We don't need to be concerned about conserving or actions that sustain the natural world for the future, because we won't be here to be concerned about it.
- The decision has been made to only protect one of the three ecosystems you visited on the field study.
- Which one would you protect and why?
- You are presenting to a decision making body that must decide where to locate a new urban structure that will virtually destroy that ecosystem. (such as a new subdivision, super highway, river crossing or major bridge). Where would you suggest they do this?
- Should the use of off-trail mountain bikes in a protected area be banning because they are threatening the health of an established protected area and presenting safety concerns to pedestrians walking on these trails?
- Should the use of spray chemicals (pesticides, herbicides, lawn fertilizers, etc) by continued because it is requested by local citizens, even if these sprays compromise the ecological health of local protected area?

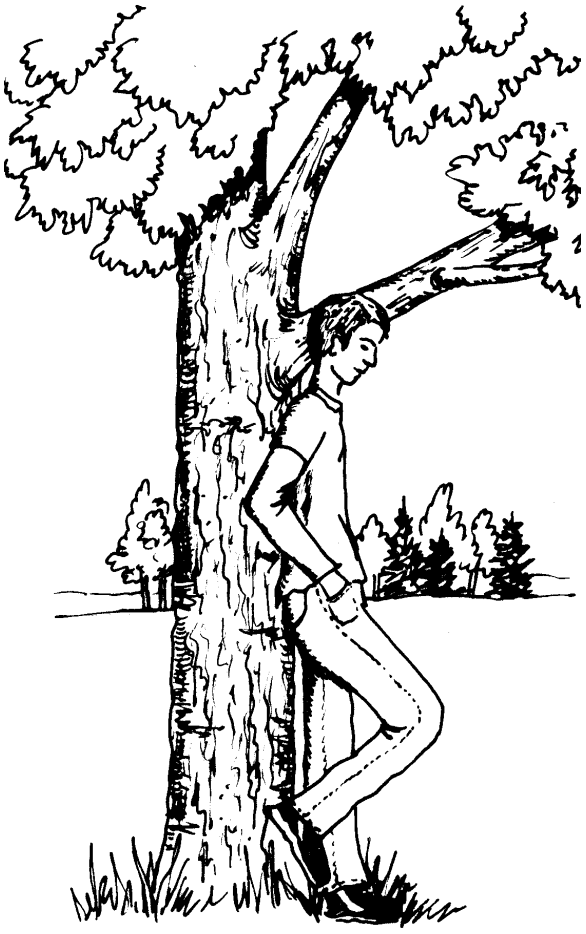
The "Nature" of Science

6.0 Conclusion to The Field Study Program

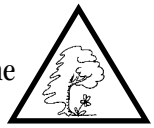
6.0 Conclusion To The Field Study Program

6.1 Who Am I?
(Part 2) Destiny of a Valley

Re-visit the story that started the day (section 2.5) which described the life of a mystery animal that actually lived here about 100 years ago (ex: grizzly bear). Describe its needs, behaviors, habits, etc.



Teacher Instructions



"Any path will do if you don't know where you're going."

Author unknown

Ask the students to remember back to the start of this field study experience. To begin the field study you read a story called Legend of a Valley. It was the story of a Grizzly Bear who returns to an environment, that 100 years earlier had provided all the components necessary for survival. Even though this area is protected, the Grizzly Bear could not survive here today. Choose one of the topics below and complete a final entry in your journal.

Topic 1

If your descendants were to visit this valley in 100 years, what do you hope they would find? What land use rules would you need to put in place today to ensure that your wish for the future comes true?

Topic 2

Could the Grizzly Bear ever return to this environment? What changes would be required to the current level of protection? How would these changes effect the current land use in the area?

Topic 3

Suppose that levels of protection for this area were removed. Tell the story of what might happen through the "eyes" of the last remaining white spruce tree.

Notes…

The "Nature" of Science

7.0
Assessment Ideas

7.0 Assessment Ideas

7.1 Assessment Rubric For Cooperative Group Work

This rubric (Appendix E8) serves to provide students with some criteria that assist in defining their personal role in completed group work associated with their group projects. It also provides a vehicle to peer assess projects and for teachers to evaluate final products.

7.2 Rubric For Student Project Assessment

Objective

To develop a list of criteria that will define complete and high quality student work. Conducting a class discussion to generate these criteria involves students in the process that evaluates their work, it removes any mysteries attached to how they are evaluated and reduces the time many students require to get to work because the goals for the final product are well established.

Time Required

10 minutes.

Teacher Instructions:

1. Re-introduce and review the projects the class is expected to complete.
2. Conduct a class discussion that develops the list of qualities a completed project would have to score full marks. Record these items on the board.
3. Prioritize between 15 and 20 of the items and ask the students to write them down.
4. Use these items as a form of self assessment, peer assessment and teacher assessment.

7.3 Post test

Objective

The goal of this post test is to assess the learning that has occurred as a result of this field study experience.

Time Required

60 minutes to complete the test.

Preparation

Photocopy one copy of the test (Appendix E9) for each student. An answer key (Appendix E10) is available.

Teacher Instructions:

This post-test is designed to test the skills and concepts practiced on the field study. This test has been written in the short answer format because this allows students the opportunity to use their individual experiences to support their conclusions, something that is not possible with a multiple choice test. This should not be the only evaluation done. Marks from this test should be combined with their project marks, any peer-assessments, participation in activities and events throughout the program and teacher observations. Provide class time to complete the test, or assign it as a take home assignment.

Notes…

The "Nature" of Science

8.0 Appendices

Appendix A
Delivering The Program In Kananaskis Country

Appendix A1
Delivering The Field Study In Kananaskis Country

Kananaskis Country is a four season, multiple-use recreation area located just 90 kilometres west/ southwest of Calgary. Its boundaries occupy 4, 250 square kilometres of land, including six provincial parks: Bow Valley, Bragg Creek, Peter Lougheed, and Elbow/Sheep Wildland, Bow Valley Wildland, and Canmore Nordic Centre.

The spectacular terrain of these wildlands ranges from grasslands, aspen parkland, montane and sub-alpine forests, as well as the ice and rock of the high alpine. There are a variety of species that roam throughout the diversity of habitats in Kananaskis Country's portion of the Central Rockies ecosystem.

The Kananaskis Country Environmental Education Program has an extensive array of publications, programs and other information of conducting field based studies in various the eco-regions of Kananaskis Country. They directly address the Alberta Course of Studies and specific learner outcomes. They are not developed as "add-on" programs. When combined with a well thought out sequence of preparatory and post field study programs, they provide an excellent vehicle for teaching the required curricula.

There are several areas within Kananaskis Country that can offer excellent opportunities for field based learning. Maps that are available free of charge indicate the numerous day-use areas that include ample parking, dry toilet facilities as well as well maintained trails. Specific information on the different areas of Kananaskis Country can be obtained through the Barrier Lake Information Centre (673-4261), Peter Lougheed Provincial Park Information Centre ((591-6345).

The Friends of Kananaskis are a cooperating association that works with Alberta Environment to promote the protection, visitor enjoyment and heritage appreciation of Kananaskis Country by enhancing its goals and activities.

Please consider the following important Procedures for Planning Field Studies in Kananaskis Country:

- THIS IS A MOUNTAIN ENVIRONMENT - WEATHER CAN CHANGE WITHOUT NOTICE TO DANGEROUS CONDITIONS. ALWAYS BE PREPARED FOR EXTREME WET OR COLD CONDITIONS.
- Have your mode of transportation remain in the day-use area. Most areas DO NOT have shelters in case of inclement weather.
- Washroom facilities are primitive and dry, consider this in your planning.
- Have students bring enough food and water to last whole day. Bring some extra for those who don't.
- Contact Visitor Centres prior to departure for seasonal concerns regarding wildlife. All species of wildlife are unpredictable and potentially dangerous.
- Some areas of Kananaskis Country are open for multi-use recreation (including snowmobiling and hunting). Consider how these other uses may affect your field study.
- Most facilities have animal proof bins for waste disposal. To avoid overextending these resources and attracting wildlife, encourage students to bring waste free lunches and leave no trace of their visit to the protected area.
- It is unlawful to feed or disturb wildlife: have your students behave accordingly when visiting any natural area.
- Kananaskis Country is a protected area, please do not remove or disturb the vegetation or landscape during your visit.

Suitable Locations For Conducting This Field Study In Kananaskis Country

Day use areas in the Natural Regions of Kananaskis Country ideal for the "Nature" of Science Program.

Middle Lake Pond, Bow Valley Provincial Park.
Dry Toilet, Parking, Waste Bin.
Excellent example of Grassland, Aspen Parkland, and Montane ecosystems.

Ribbon Creek, Kananaskis Valley
Dry Toilet, Parking, Waste Bin.
Aspen Parkland, Montane, and Sub-Alpine Ecosystems.

Yamnuska Natural Area, 1A Highway
Primitive Area. No Parking, No Waste Bins, and No Toilet Facilities
Excellent example of Grassland, Aspen Parkland, Montane and Marsh ecosystem in primitive setting.

Sibbald Meadows Pond, Sibbald Flats Area
Parking, Waste Bins, Dry Toilet Facilities
Aspen Parkland, Sub-Alpine Forest, Marsh.

Pocaterra Creek, Peter Lougheed Provincial Park
Visitor Information Centre, Parking, Waste Bins, Dry Toilet Facilities
Fen, Sub-Alpine and Sub-Alpine meadows.

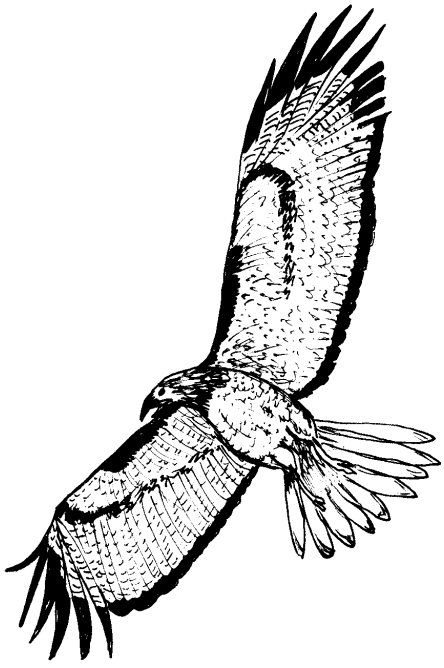
Elkwood, Peter Lougheed Provincial Park
Visitor Information Centre, Parking, Waste Bins, Dry Toilet Facilities
Fen, Sub-Alpine and Sub-Alpine meadows.

Ptarmigan Cirque, Highwood Pass, Peter Lougheed Provincial Park
Parking, Waste Bins, Dry Toilet facilities
Excellent example of Sub-Alpine, Alpine and Alpine Meadows.

Alder Trail, Bragg Creek Provincial Park, Elbow River Valley Area
Parking, Waste Bins, Dry Toilet facilities
Aspen Parkland and mixed forest.

Moose Mountain, Elbow River Valley Area
Parking, Waste Bins, Dry Toilet Facilities
Aspen Parkland, Sub-Alpine, Alpine.

Windy Point Trail, Sheep River Valley Area
Primitive. No Parking, Waste or Toilet Facilities
Excellent example of Grassland, Aspen parkland, and Sub-Alpine ecosystem in primitive setting.



Appendix A2 -
Teacher Information

The "Nature" of Science
Parks And Protected Areas Rules

Many school conduct field studies in protected areas such as Provincial Parks, Wildland Parks, Wilderness Reserves and Natural Areas. The following are commonly held rules to remember when interacting with a protected area. These rules reflect the provincial parks and protected areas mandate to protect and conserve the natural environment.

- Wildlife live in these areas because they are able to meet their needs for food, water and shelter. Feeding them is not necessary. In fact, it can create significant hardships for them because they become dependent on this food and the learned behaviors associated with this can also be dangerous for them. **Do not feed or harass wildlife.** Observe them quietly instead.

- Thousands of people visit Kananaskis Country each year. If each person took only one cone or picked one plant that still represents a very significant impact on the natural environment. **Cutting, defacing, picking or removal of any plant, fossil, rock or other material is prohibited.** Leave them behind for others to enjoy and for animals to use.

- Thousands of people visit Kananaskis Country each year. If each person threw their garbage on the ground it would be difficult to clean up and dangerous for wildlife who could confuse the litter for food. **Litter should be placed in garbage cans or in your pocket** if no garbage cans are available.

- For as much as is possible, this area should remain a natural place. Wildlife are not accustomed to pets chasing them or threatening them with noise. For these reasons **pets must be on a leash.** This not only protects wildlife it also protects people and their pets as well.

- To preserve and protect our natural environment we must be very careful with how we interact with the natural areas. Open fires are a threat to habitat which includes animals and plants. For these reasons, **campfires are permitted only in designated firepits** located in some picnic areas.

Appendix B Environmental Literacy

Appendix B1 Environmental Literacy: Action or Activism

There is a profound, but subtle, distinction between environmental education and environmental literacy. While environmental education is process based, the goals of environmental literacy are more outcome based. **Environmental literacy is defined as the capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those systems.** An environmentally literate person is the ultimate goal of environmental education. It requires that students go beyond what has typically been expected of them, to merge a wider range of knowledge and thought processes that ultimately lead them to an intrinsically motivated decision about an environmental issue. This appreciation of the relative health of the planet leads to changes in personal lifestyle behaviors that reflect a connection to the earth. This is, however, more than what has historically been considered environmental action. Environmental literacy considers many forms of thought and leads to behavioral changes that are personal and life long. These behaviors are much more than recycling of lunch garbage or riding your bike instead or driving a car. Environmentally literate people adopt behaviors that reflect an understanding of the relative health of the ecological systems that sustain the earth.

Throughout this field study efforts have been made to consider all of the elements of environmental literacy and integrate them into the activities that comprise the preparatory activities - field study - post activities sequence of events.

There is a difference between personal and group action and activism. This field study does not encourage activism. Instead it endeavors to provide an experience that helps enable students to adopt individual actions, lifestyles behaviors and decision making processes that consider the relative health of the planet and the impact their choices will have on the life systems of the earth.

For more information on environmental literacy and how it can be integrated into every day teaching and learning strategies, please contact Kananaskis Country Environmental Education program at 403-678-5508.

Appendix B2 - Teacher Information

What Characterizes An Environmentally Literate Person?

While concern for the environment has steadily increased over the past 40 years, there has been little fundamental change in human impact on the relative the global ecosystem. Environmentally literate citizens are individuals who adopt lifestyles, behaviours and consumer choices that reflect an understanding of how these choices impact the health of the planet. Environmentally literate people hold some unique abilities:

1. Ability to think in terms of systems.

Ecology's central message is that everything is connected. An ability to analyze and understand our actions in terms of how they impact the life systems of the planet characterized environmental literacy.

2. Ability to think ahead.

The ability to project the long term results of behaviors and actions; to extend beyond the quick fix solutions into actions that are truly long term and sustainable, characterizes environmental literacy.

3. Ability to think critically about issues which involve personal values and beliefs.

The ability to respect, consider and evaluate all aspects of an issue, to clarify what we value as important and adopt behaviors in keeping with these ideals characterizes environmental literacy.

4. Ability to move from awareness to understanding to positive action.

Simply being aware of an issues does not lead to any positive actions that assist in solving concerns. The ability to convert awareness into positive action and issues resolution, leads to greater knowledge and understanding.

5. Ability to distinguish reality from the projected.

We are surrounded by visual images of the natural world that many of us will never have the good fortune of visiting. The ability to distinguish these images from the reality of the relative health of the planet characterizes environmental literacy.

6. Ability to learn new concepts and unlearn old ones.

Humans are consistently presented with new knowledge. Environmentally literate people are life long learners who are able to interpret new knowledge and replace old knowledge. They have the ability to apply environmental concepts, to learn new concepts and challenge current thinking.

7. Ability to communicate.

The ability to communicate in verbal and written forms, to articulate thoughts and ideas and to offer persuasive and informed arguments characterizes environmental literacy.

8. Ability to value the aesthetic as well as the conceptual.

Much of what we learn about the earth is science based, conceptual and academic. Environmentally literate people extend beyond this to recognize the value of such things as beauty, harmony and balance and include these in decision making processes.

9. Ability to make a long term commitment to work cooperatively on issues of concern.

There is no environmental problem that we can expect one person to solve. Many of these concerns are very complex and require a cooperative effort to both identify the problem while charting and carrying out a solution.

10. Ability to critically evaluate the effects of change before influencing change.

Change is inevitable. To be able to effectively evaluate change, both personal and in others and reflect on these changes, in terms of the health of the planet, characterizes environmental literacy.

Appendix C
Preparatory Activities

Appendix C1 - Teacher Instructions

Slides For Use In Activity 2.1: Program Introduction

1. Select a recent local news item that discusses an environmental issue. Introduce this to the students.
2. Select six slides, (Appendix C1). or use the ones provided, that represent images of areas that your students are familiar with. These could include a local playing field, shopping mall, green space, before and after pictures of a developing area, historical pictures and modern day pictures of the same location, provincial park, protected area or residential backyard for example.
3. Show the first slide and ask the students some questions about the slide. Discuss the thoughts that come forward.

- Is this a protected area?
- Is this area worth protecting? why or why not?
- What types of protection do you see in the image?
- What would happen to this area if there was no type of protection for it?
- What land uses (natural and human) do you see in the image?
- What plants and animals do you see in the image?
- What ecosystems do you see represented in the image?
- What evidence of human activity do you see? Do these represent good or bad influences?
- What would you do to sustain the existing environmental quality of the area in the slide?

4. Show the second slide and continue the conversation. The last slide you show should be an image of the natural area being visited on the field study.
5. Summarize the activity with a discussion about decision making. Decisions are made based on the best available information from all sources and viewpoints at the time of the decision. When new information becomes available it can mean revisiting, and perhaps changing, an old decision.

This is the "nature" of science. Science does not provide all the answers to environmental issues. It offers a perspective that must be considered along with many others. Science involves applying what you know, to what you do not know, to learn something new. This field study will introduce many ecosystems, environments, issues, environmental concerns and challenges that have many solutions. The challenge is to gather and consider all the data before a decision is made and not to be afraid to change that decision when new information becomes available.

Appendix C2 -
Student Instructions

The "Nature" of Science

Scientific Team Roles

Student scientific teams, using the following roles, will explore a variety of ecosystems during the field study. Here is a description of the role of each scientist on the team.

Curator

Complete masthead information: Record data about the ecosystem, date, weather, etc.
Scale drawing of entire transect: Use the clinometre to draw a scale cross section profile, that demonstrates the height variance of objects along the transect.
Other: Record data on the ecosystem card as it is collected.

Photographer

Slope: Use the clinometre to determine the angle of the slope for the entire transect line.
Aspect: Use a compass to determine the direction that your transect and quadrat faces.
List equipment and materials used.
Other: Complete colourful rubbings of items in the area being explored. Record the entire event with photographs, slides or video.

Researcher

Temperature: Use air and soil thermometers to record temperatures 1 metre above ground, at ground level and below the ground level within the quadrat.
Light: Use a light metre to measure light intensity in a variety of locations within the quadrat.

Zoologist

Wind: Make observations about wind strength and the factors that influence the impact of wind within the quadrat area.
Evidence of biotic features: Collect data on observations about biotic features in the quadrat area such as animal browse markings, nests, burrows, tracks, scat, animal trails, scratch marks on trees or logs, etc.

Botanist

Soil profile: Use a soil plug to collect soil and diagram a cross section of the soil within the quadrat.
Soil compaction: Determine if the soil has a high, medium or low degree of compaction ability within the quadrat area.
Soil moisture: Determine if the moisture level in the soil is high, medium or low within the quadrat area.
Soil pH: Use pH paper, pH pens or pH testing kits to determine the pH of the soil at various places within the quadrat area.

Everyone Is Expected To Make Contributions About The Following:

Detail of area in quadrat, including plant identification and populations: Draw an accurate scale diagram of the interior of the quadrat area. This should reflect consideration of all the criteria mentioned in this list.

Evidence of human impact: Record observations about the impact humans have had on the overall area. Not just in the present, but make reflections about obvious historical uses by looking around the area for evidence of human activity.

Aesthetic features: Describe the aspects of the quadrat area that are appealing to humans. These are features that make this ecosystem unique from all others, and that people enjoy when in this ecosystem. These could be wildflowers or unique plants, colourful leaves, unique animal features, sounds, smells, etc.

List any unique observations.

List the land uses that are present:
Generate a list of land uses you observe in the area.

Appendix C3 - Student Data Gathering Sheet

The "Nature" of Science

Ecosystem Card

Ecosystem: _____

_____

Date: _____ Time: _____

Weather: _____

Group members:

curator: _____

photographer: _____

researcher: _____

zoologist: _____

botanist: _____

Instructions

1. As a class group select a transect site and stretch out the long 30 metre rope.
2. Designate the quadrat intervals and locations for each individual group.
3. Use the shorter ropes and pegs to rope out each quadrat area.
4. Collect data observations, as outlined on this ecosystem card.
5. On a separate sheet of large paper complete a detailed drawing of the interior of the quadrat. Use the grid squares to map out the interior of your quadrat.

Scale Drawing of Transect Profile

Use the clinometre to create a scale drawing of a profile of the entire transect line.
Follow the instructions on Appendix C8 to complete this section.

Detail Of Quadrat Interior

On a separate large blank sheet of paper complete a scale drawing of a top view of the area within your quadrat. Use the grid square to gather observations about all the areas outlined on the ecosystem card. Be sure to include detail pictures of all plants, locations of all the items gathered and tested and population numbers for the various plant species identified.

Temperature

Use the air and soil thermometers to gather readings for the following. Be sure the thermometers are not directly in the sun and are left for at least 2 minutes to accurately reflect the temperature of the area.

2 metres above the ground:_____
1 metre above the ground: _____
at ground level: _____
10 cm below the ground: _____

Light

Set the light metre at between and 2 and 5 different locations within the quadrat area and record the light intensity. Average these numbers and record this data below.

light metre readings: _____
average:_____

estimated hours of sunlight: _____

Objects that diminish light in the area over the course of a day:_____
_____
_____

Slope

Use a clinometre to determine the angle of the slope your transect is on. Be sure to use the entire transect, not just the section the quadrat your group is working is placed.

The slope is _____ degrees.

Soil Moisture

Collect 2 or 3 soil plugs and make a determination about the average moisture level of the soil in your quadrat that the entire group can agree on. Rank the moisture level on a scale from 1 to 10, with 1 being very dry and 10 being very wet.

Dry Wet
1 2 3 4 5 6 7 8 9 10

Soil Type

Describe the type of soil.

Soil Compaction

Remove another soil plug and gather a handful of soil in your hands. Squeeze the soil tightly in your hands. Then open your hands and describe how the soil behaves. Does it stay in a tight ball, fall apart, or do something else? Compare a few soil plugs removed from different areas within your quadrat.
Record your observations.

Is the soil in your quadrat:
_____ highly compatible
_____ medium compatible
_____ low compatible

Soil and Humus Profile

Use the soil plug tool to remove a cross section of the soil within the quadrat your group is exploring. Use the soil samples to draw a detailed diagram of the cross section that includes:

- careful labeling of each layer of soil
- measurements of the thickness of each layer
- descriptions of the components of each layer.

Be sure to return the soil plug back into the hole you removed it from.

Wind

After recording observations for each of the questions below, make a deterniation of the effects of wind on the quadrat your group is exploring,

Describe the exposure this area has to the effects of wind _____

_____

_____

_____

_____

Describe the objects that influence wind patterns for this area. _____

_____

_____

_____

_____

Is the presence of wind in this area:

_____ high _____ medium _____low

Aspect

Use the compass to determine the direction that the quadrat you are exploring is facing. Stand at the up-hill side of the quadrat and look down hill towards the other side of the quadrat.
What direction (in degrees and words) does this line indicate.
For example: South / 180 degrees.
Draw an arrow on the compass below and record the degrees.

North

West East

South

Evidence of Biotic Features

Carefully explore the area within the quadrat for evidence of animal tracks, burrows, nests, scat, animal trails, scratching marks, food caches, browsing, etc. Record your observations below and on the quadrat detail.

_____

_____

_____

_____

_____

pH

Use the test materials available to determine the pH of the soil. Gather at least 3 to 5 soil samples from different locations with in the quadrat. Test the pH of each sample and record the average soil pH below.

test 1:

_____

test 2:

_____

test 3:

_____

test 4:

_____

test 5:

_____

average soil pH:

_____

Land Uses

Describe the land uses you can see within view from your quadrat area. Be sure to consider historical uses as well as ones you can see today.

_____

_____

_____

_____

_____

_____

_____

_____

Aesthetic Features

Describe the unique features of this ecosystem that humans would find appealing. These could be such things as flowers, colours, smells, viewpoints, etc.

Equipment / Materials

Create a list of the equipment and materials your group used to complete this ecosystem exploration.

Human Impacts

Describe the human impacts you observe evidence of that are within view from your quadrat area. Be sure to consider historical human impacts, not just ones you can see today.

Observations

Record any observations you make that don't fit into any of the other categories on this ecosystem card.

Appendix C4 - Student Worksheet

The "Nature"of Science:

Soil pH Study

Student Name:

_____

Date:

_____

Materials:

pH test paper or indicator or pH test pen, samples of various strength acid and base solutions, data sheet.

Student Directions:

1. Collect a small sample from one of the numbered beakers. Note the number of the beaker.
2. Test for pH level.
3. Enter the data in the chart and on the pH scale below. Indicate if the item tested is acidic (A), neutral (N), or base (B).
4. Repeat for all other samples.

Observations:

Sample Number	pH level	Acid (A) /neutral (N) /base (B)
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	_____
6	_____	_____
7	_____	_____
8	_____	_____
9	_____	_____
10	_____	_____

pH Scale

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Appendix C5 - Student Worksheet

The "Nature" of Science:

Moisture Content In Soil (Demonstration)

Student Name:

_____

Date:

_____

Materials:

vials, soil samples, scale, data sheet

Student Directions:

1. Collect soil samples.
2. Record mass (MASS A) of each sample in column A on the data sheet.
3. Spread each sample out on paper towel and allow to dry out completely.
4. Record dry mass (MASS B) in each sample in column B on the data sheet.
5. Calculate the mass of the moisture lost (MASS C) from each sample:
   Subtract B from A - record in column C (moisture mass).
6. Calculate the percentage (%) of moisture lost from each sample:
   Divide mass from column C by the mass from column A - record as column D.
7. Multiply column D by 100 to get % of moisture in each sample. Record under (%)

Observations:

Sample Number	Column A (Mass A)	Column B (Mass B)	Column C (Mass C)	Column D	(%)
1	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____

Analysis and interpretation

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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_____

_____

_____

_____

Appendix C6 - Student Worksheet

The "Nature" of Science:

The Effects Of Wind

Student Name:

_____

Date:

_____

Materials:

ruler and streamer, schoolyard map, data sheet

Student Directions:

1. Visit each of the objects identified in the chart below.
2. Indicate their location of the schoolyard map.
3. Hold the ruler/streamer at different places around and near the object in an effort to understand how wind is effected by the object.
4. Record you data in the chart below.

Object	Observations
open field	
small ground cover plants less than 30 cm high	
school building (describe the spot)	
trees	
tall shrubs (taller than 30 cm)	
hills / slopes	
facing in different directions	
north	
south	
east	
west	
other objects	

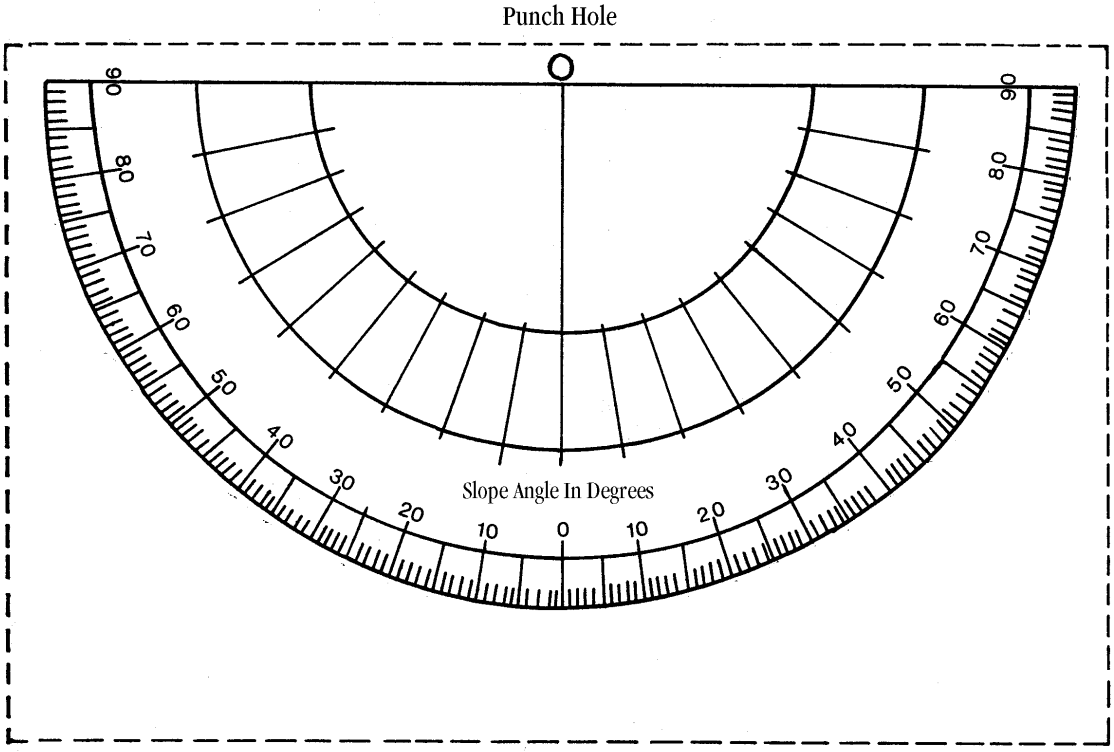
The "Nature" of Science:

Clinometre Faceplates

Photocopy as many faceplates as required.

Assembly

1. Photocopy the required number of clinometre faceplates.
2. Cut out the clinometre template and a cardboard backing that is the same size.
3. Glue the clinometre template to the cardboard backing.
4. Punch a hole in the clinometre at the centre of the base line.
5. Measure and cut a piece of string or fishing line about 11 cm long.
6. Tie a small washer onto one end of the string and tie the other end through the hole in the base line. Set the length of the string such that the scale appears inside the hole in the washer when the washer is hanging down the front of the clinometre.



Appendix C8 -
Student Data Gathering Worksheet

The "Nature" of Science:

Scale Drawing of Transect Profile

Student Name:_____

Date:_____

Instructions:

1. Walk along entire transect and complete a top view of the objects along the line. Be sure to include the objects within an area 1 metre out from each side of the rope transect.

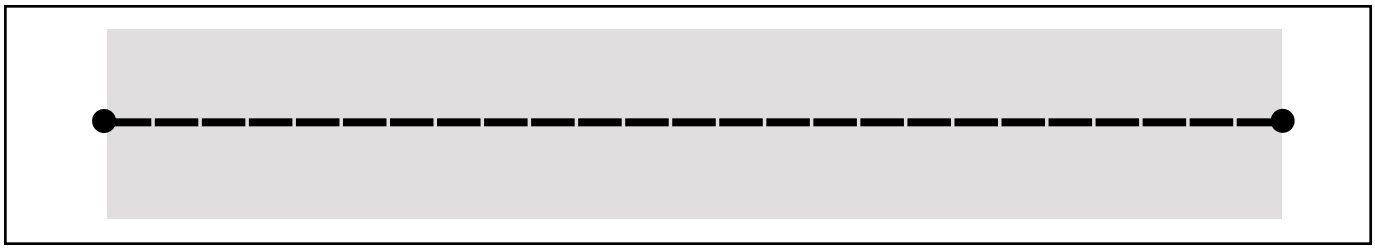
2. Label all objects

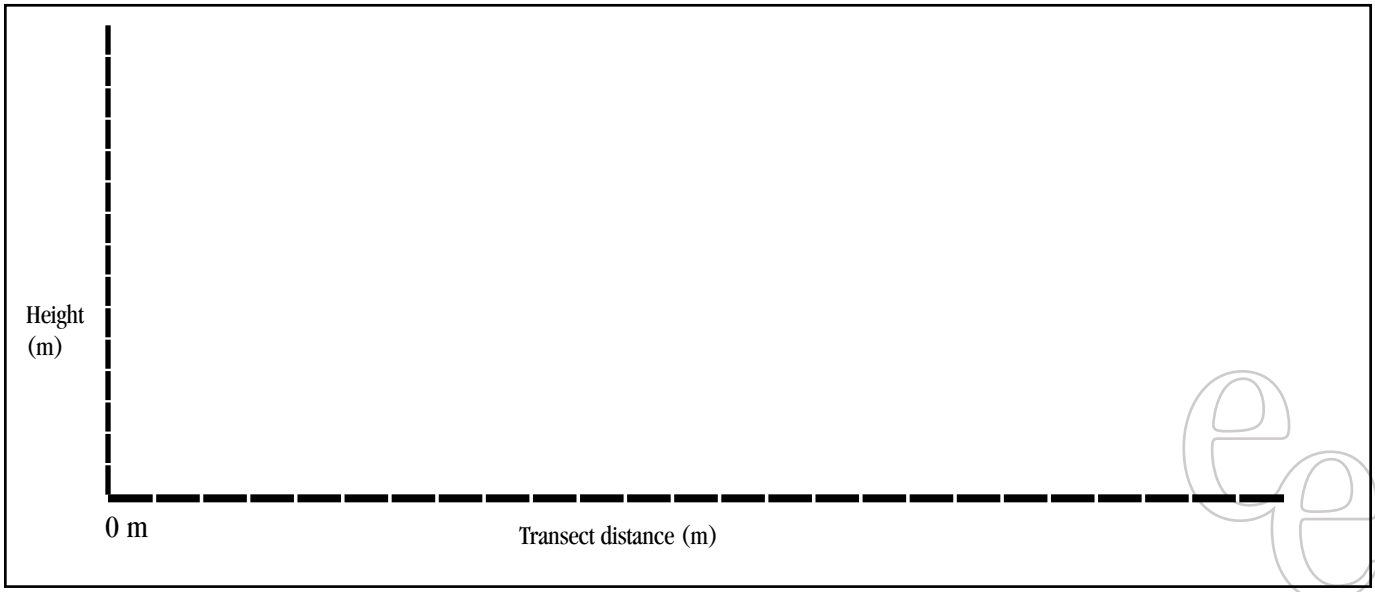
3. Include the position of your scientific team's quadrat.

4. Use the top view information and your clinometres to complete a cross section of the transect.

Degrees of slope (at 9 metres from the base of the object)	Height (in metres)
10 degrees	1.5 metres
20 degrees	3.0 metres
30 degrees	5.0 metres
40 degrees	7.5 metres
45 degrees	9.0 metres
50 degrees	11.0 metres
60 degrees	15.5 metres
70 degrees	25.0 metres
80 degrees	51.0 metres

Draw a scale, profile (side view) of the transect objects using the data you have gathered.





Appendix C9 - Student Worksheet

The "Nature" of Science:

Describing An Ecosystem Questions

Student Name:_____

Date:_____

Develop five questions that when answered would result in a detailed and accurate definition of any ecosystem you visited.

1. _____

_____

_____

_____

2._____

_____

_____

_____

3._____

_____

_____

_____

4._____

_____

_____

_____

5._____

_____

_____

_____

_____

Additional Questions

1._____

_____

_____

_____

2._____

_____

_____

_____

3._____

_____

_____

_____

4._____

_____

_____

_____

5._____

_____

_____

_____

_____

6._____

_____

_____

_____

_____

_____

Appendix C9.1 - Student Worksheet

The "Nature" of Science:

Describing An Ecosystem Chart

Student Name: _____

Date: _____

Ecosystem:_____

What are the primary abiotic features? _____

_____

_____

_____

_____

What are the primary biotic features? _____

_____

_____

_____

_____

What are the main producers? _____

_____

_____

_____

_____

What are the main consumers? _____

_____

_____

_____

_____

What are the main decomposers? _____

_____

_____

_____

_____

What unique adaptations do the plants and animals have? _____

_____

_____

_____

_____

What are the hardships and challenges organisms in this ecosystem face? _____

_____

_____

_____

_____

How does the ecosystem change over the course of the seasons? _____

_____

_____

_____

_____

Appendix C10 - Student Worksheet

The "Nature" of Science:

What Is A Protected Area?

One

_____

Name (don't write your name until you are asked to)

_____

Date

Think of a place that is really important to you. Answer the following questions:

1. Describe the place that is really important to you without naming it _____

_____
_____
_____
_____
_____

2. Why is this place so important to you? _____

_____
_____
_____
_____
_____
_____

3. How do you ensure that this place never gets damaged or destroyed? _____

_____
_____
_____
_____
_____
_____

4. What would you do if a friend threatened this place? _____

_____
_____
_____
_____
_____
_____

5. Is this place as important to everyone else as they are to you and why? _____

_____
_____
_____
_____
_____
_____

6. How do you indicate to others that this place is important to you? _____

_____
_____
_____
_____
_____
_____

Appendix C10.1 - Student Worksheet

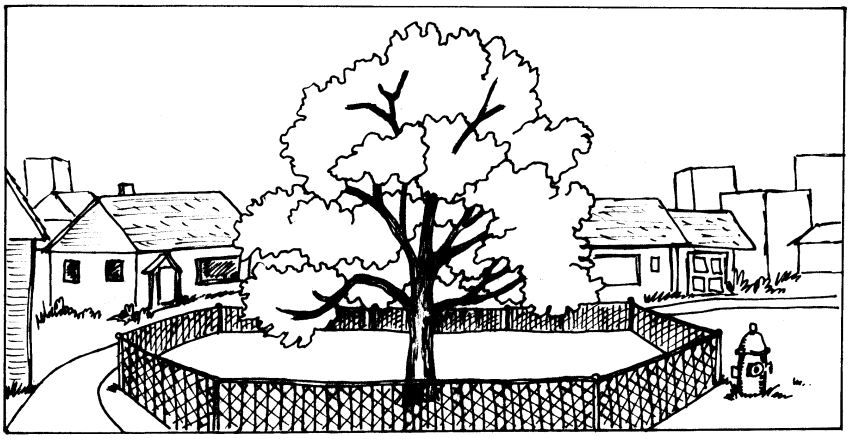
The "Nature" of Science:

What Is A Protected Area?

Two

Move around the classroom and read the posted sheets. Ask your classmates questions, that can be answered with a yes or a no, in an effort to determine who wrote each of the posted sheets.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27. _____
28. _____
29. _____
30. _____
31. _____
32. _____
33. _____
34. _____



The "Nature" of Science:

Slides: Land Uses And Activities In Protected Areas

Teacher Instructions:

1. As a class, go for a tour of your community, or at least view your community from various points, while remaining on school property. (See section 2.8.2. for details)
2. Make a list of all the land uses that you see.
3. Back in class review and share the lists that are produced.
4. Through the use of slides add to these lists of land uses.
5. Divide the class up into their research groups and designate a different type of ecosystem for each group.
6. Challenge each group to design a land use map (on grid paper) of an area, such that all land uses, brainstormed by the class, are included without compromising the relative health of the ecosystem.

Students will most likely indicate they can't include all the land uses on the list without compromising the relative health of the ecosystem. If this is the case, develop a prioritized list of the land uses and their impacts. Then re-design your map in such a way that everyone can co-exist together.

Appendix D
Field Study

Student Activity Sheets

Appendix D1 - Student Worksheet

The "Nature" of Science Scavenger Hunt Questions

Scientific Team Members:

_____

_____

_____

Directions:

1. Your scientific team has 45 minutes to complete as much of the scavenger hunt as possible. The answers to all of the following questions are found within the immediate area. You need not travel any longer than 20 minutes in any direction.
2. Remember to not collect anything. When they find evidence or the answer to a question, the team should either draw a picture of it or describe it in the space provided on your data gathering sheets.
3. Note that each question is worth points.

Boreal Forest Ecosystem

1. Go to the boreal forest ecosystem. Locate the dominant tree species in this ecosystem. Look for the tallest tree that you can find.

a. Use your estimation skills to predict the height of this tree. (1 point) _____

b. Describe the needles found on this tree. (1 point)

_____

_____

_____

c. Do a bark rubbing of this tree. (2 points)

_____

Bonus 5 points: What is the name of this tree?

_____

2. Look below this dominant tree.

a. Count the number of different types of plants that are found below this tree. (1 point)

_____

b. How might you explain the limited number of species found here? (2 points)

_____

_____

c. Draw a leaf of one of the plant species that you see. (2 points)

3. Locate the micro-environment that has the lowest temperature in this ecosystem.

a. Describe the micro-environment and record the temperature here. (1 point)

_____

_____

_____

_____

_____

b. Then locate the micro-environment that has the highest temperature in this eco-system. (1 point)

_____

_____ /11 Bonus: _____ /5

c. Describe the micro-environment and record the temperature here. (2 points)

_____

_____

_____

_____

d. What is the temperature differential in this ecosystem? (1 point)

_____

4. Describe/draw evidence that humans and wildlife share this environment. (4 points)

_____

_____

_____

_____

_____

5. List 3 things that you **saw** which showed you that wildlife lives in this area. (3 points)

1. _____
   _____
2. _____
   _____
3. _____
   _____

6. Name three things that you **heard** which showed you that wildlife lives in this area. (3 points)

1. _____
   _____
2. _____
   _____
3. _____
   _____

7. Name 3 things that you **smelled** which showed you that wildlife lives in this area. (3 points)

1. _____
   _____
2. _____
   _____
3. _____
   _____

8. Describe/draw evidence that plants must have specific adaptations to survive in this ecosystem. (4 points)

_____

_____

_____

_____

_____

9. Describe/draw evidence that animals must have specific adaptations to survive in this ecosystem. (4 points)

_____

_____

_____

_____

_____

_____ /24

10. Describe the evidence of the activities of a decomposer. (1 point)

_____

_____

_____

_____

Grassland Ecosystem

11. Go to the grassland ecosystem. Locate the dominant plant found in this area.

a. Estimate the height of this plant. (1 point)

_____

b. Look closely to see if you can see any evidence of the relationship between this plant and an animal or animals. Describe this relationship below. (2 points)

_____

_____

_____

Bonus 5 points: Is this relationship an example of mutualism, parasitism, or commensalism?

_____

_____

_____

12. Locate the micro-environment that has the lowest temperature in this ecosystem.

a. Describe the micro-environment and record the temperature here. (1 point)

_____

_____

_____

b. Then locate the micro-environment that has the highest temperature in this eco-system. Describe the micro-environment and record the temperature here. (1 point)

_____

_____

_____

c. What is the temperature differential in this ecosystem? (1 point)

_____

13. Describe/draw evidence that humans and wildlife share this environment. (4 points)

_____

_____

_____

_____

14. List 3 things that you **saw** which showed you that wildlife lives in this area. (3 points)

1. _____

_____

2. _____

_____

3. _____

_____

_____ /14 bonus: _____ /5

15. Name three things that you **heard** which showed you that wildlife lives in this area. (3 points)

1. _____
   _____
2. _____
   _____
3. _____
   _____

16. Name 3 things that you **smelled** which showed you that wildlife lives in this area. (3 points)

1. _____
   _____
2. _____
   _____
3. _____
   _____

17. Describe/draw evidence that plants must have specific adaptations to survive in this ecosystem. (4 points)

_____
_____
_____
_____

_____

18. Describe/draw evidence that animals must have specific adaptations to survive in this ecosystem. (4 points)

_____
_____
_____
_____

_____

19. Draw a detailed diagram of a grassland wildflower bloom. (4 points)

_____

20. Estimate the diameter (in centimetres) of the entrance to a ground dwelling animal burrow. (1 point)

_____

_____ /19

Aspen Woodland Ecostystem

21. Go to the aspen woodland ecosystem. Locate the dominant tree species in this ecosystem. Look for the tallest tree that you can find.

a. Use your estimation skills to predict the height of this tree. (1 point) _____

b. Do a bark rubbing of this tree (1 point)

_____

c. Describe the leaves, buds, flowers, and or seeds (depending on the season). (1 point)

_____

_____

_____

Bonus 5 points: What is the name of this tree?

_____

22. Look below this dominant tree.

a. Count the number of different types of plants that are found below this tree. (1 point)

_____

b. Draw a leaf of one of the plan species that you see. (1 point)

_____

c. How might you explain the number of species found here? (2 points)

_____

_____

_____

_____

23. Locate the micro-environment that has the lowest temperature in this ecosystem.

a. Describe the micro-environment and record the temperature here. (1 point)

_____

_____

_____

_____

b. Then locate the micro-environment that has the highest temperature in this eco-system. Describe the micro-environment and record the temperature here. (2 points)

_____

_____

_____

_____

c. What is the temperature differential in this ecosystem? (1 point)

_____

24. Describe/draw evidence that humans and wildlife share this environment (4 points)

_____

_____

_____

_____

_____

_____ /15 bonus: _____ /5

25. List 3 things that you **saw** which showed you that wildlife lives in this area. (3 points)

1. _____
   _____
2. _____
   _____
3. _____
   _____

26. Name three things that you **heard** which showed you that wildlife lives in this area. (3 points)

1. _____
   _____
2. _____
   _____
3. _____

27. Name 3 things that you **smelled** which showed you that wildlife lives in this area. (3 points)

1. _____
   _____
2. _____
   _____
3. _____
   _____

28. Describe/draw evidence that plants must have specific adaptations to survive in this ecosystem. (4 points)

_____
_____
_____
_____

_____

29. Describe/draw evidence that animals must have specific adaptations to survive in this ecosystem. (4 points)

_____
_____
_____
_____

_____

_____ /17

Total Score: _____ /100

Bonus Score: _____ /15

Grand Total;: _____

The "Nature" of Science:

Appendix E Post Field Study Student Activity Sheets

Appendix E1 - Teacher Overhead

The "Nature" of Science:

Connecting Ecosystems Student Instructions

Instructions

This is an opportunity for you and your scientific team to gather additional data about the ecosystems you visited on the field study.

1. Move to the first station you have been assigned to.
2. On the large sheet of paper that is available add all the information you can from your field study notes, following the categories on your **Ecosystem Card**, and the categories described below.
3. When asked to move, travel to the next station. Continue the work started by the previous group by continuing to add information from your field study notes to the large ecosystem diagram.
4. Add any information you gathered on the field study that is not on the large sheet already.
5. If there is information on the large ecosystem diagram, that you do not have in your notes, add this information to your notes so you will have it to use later.
6. Continue to move through all the stations repeating this process at each large ecosystem diagram station.

After you have visited all the stations you should have a detailed and comprehensive collection of data about all three ecosystems. This data will be used to complete the projects and activities that conclude the "Nature" of Science program.

Appendix E1.1 - Student Worksheet

The "Nature" of Science:

Connecting Ecosystems Student Instructions

Station One Set-Up

Set up the large sheet of paper with the following categories and leave space for each group to add their own information.

Ecosystem:_____

_____

Date: _____

Weather when data was gathered:

_____

_____

_____

Scale Drawing of Transect Profile

Create a scale drawing of a profile of the entire transect line.

Detailed Drawing of The Ecosystem

Use the data gathered during the quadrat study to draw a detailed diagram of the portion of the transect that your group explored during the field study.
Be sure to include:

- a diagram and description of the overall geography (landscape). Be sure the angle of the **Slopes** drawn in the diagram match the slope measurements you noted on the field study.
- a complete scale diagram and describe the trees, shrubs, plants you observed
- a complete scale drawings of animals that live there (according to any evidence you found) information about the following measurements:

Aspect

Add the drawing of a directional compass to indicate the orientation (north - south - east - west) of the drawing of the ecosystem.

Light

Indicate the light readings your group recorded for the following:

- light metre readings
- estimated hours of sunlight
- Objects that diminish light in the area over the course of a day

Temperature

Indicate the temperature readings your group recorded for the following:

- 2 metre above the ground
- 1 metre above the ground
- at ground level
- 10 cm below the ground

Soil Moisture

Locate a place on the diagram that is similar to the location you used to gather the soil plug used to determine soil moisture.
Indicate the moisture level your group noted at this location in the ecosystem.

Soil Compaction

- Locate a place on the diagram that is similar to the type of area you used to gather the soil plug used to determine soil compaction.
- Indicate your observations at this location on the diagram.

Soil and Humus profile

- Select a spot on the diagram that approximates the location you used to collect the soil plug sample. Complete a detailed drawing of the soil profile you collected.

Wind

- Draw some examples of how wind effects the ecosystems. Record some written observations about how wind effects the ecosystem.
- Diagram and describe the exposure this area has to the effects of wind.
- Describe the objects that influence wind patterns for this area.
- Is the presence of wind in this area:
  ___high ___medium ___low

Evidence of Biotic Features

- Draw and label your observations of the biotic features you found in the ecosystem quadrat. These could include: evidence of animal tracks, burrows, nests, scat, animal trails, scratching marks, food caches, browsing, etc.

pH

- Indicate the locations you used to collect samples to test for pH. Note the average pH level your recorded.

Land Uses

- Describe the land uses you can see within view from your quadrat area. Be sure to consider historical uses as well as ones you can see today.

Aesthetic Features

- Describe the unique features of this ecosystem that humans would find appealing. These could be such things as flowers, colours, smells, viewpoints, etc.

Human Impacts

- Describe the human impacts you observe evidence of that are within view from your quadrat area. Be sure to consider historical human impacts, not just ones you can see today.

Equipment / Materials

- Create a list of the equipment and materials your group used to complete this ecosystem exploration.

Observations

- Record any observations you make that don't fit into any of the other categories on this ecosystem card.

Appendix E2 - Student Worksheet

The "Nature" of Science

Lab Report Guidelines

A complete lab report should contain the following information and characteristics.

- a description of the problem,
- your prediction(s) of the possible solutions to the problem and guiding questions,
- a description of the scientific process you followed throughout the field study,
- a detailed summary of the observations gathered on the field study,
- interpretation and analysis of the observations your group made,
- recommendations, that are directed at the scenario and guiding questions (1.5), about what you would suggest be done to protect the ecosystems visited on the field study,
- graphs, graphics and pictorial data that support any lab report recommendations,
- answers to the questions suggested above and in the problem described in section 1.5 and 5.0
- a complete Student Reflection Journal
- evidence of a content and language edit
- correct spelling, grammar and language structure
- completed "Assessment Rubris For Cooperative Group Work" (see reverse side for rubric)
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

The "Nature" of Science:

Unknown Species Key

For PART 1 of the Unknown Species activity cards have been developed for the following:

Ecosystem	Unknown Species Card Number	Species Name
ecosystems	2	Mule Deer
	11	Wild Prickly Rose
Aspen Parkland	10	Saw-whet Owl
	9	Goldenrod
Grassland	8	Creeping Juniper
	6	Garter Snake
Boreal Forest	7	Sphagnum Moss
	4	Mink

Displaced Species

At one time a variety of species lived in the ecosystems visited on the field study, but for a variety of reasons, they no longer can be found there. To provide a vehicle to discuss displaced or endangered species three additional Unknown Species Cards have been developed for:

Unknown Species Card Number	Species Name
3	Timber Wolf
1	Grizzly Bear
5	Wolverine.

Appendix E3.1 - Student Worksheet

The "Nature" of Science:

Unknown Species Card

Species Card: **1**

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species 1" sheet.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

_____ producer

__√__ consumer:

_____herbivore

_____carnivore

__√__ omnivore

_____ decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?

Temperature Range: not an issue because this species sleeps when it's cold

What is the preferred temperature (degrees Celsius) this species likes to live in?

Preferred Temperature Range: 12 - 20 degrees Celsius

What is the sunlight level and intensity this species prefers?

Preferred light levels _____ high _____medium
_____ low __√__ NA

What is the preferred moisture level this species likes in its ecosystem?

Preferred moisture levels_____high __√__medium
_____low _____N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.

Preferred soil type _____acidic _____neutral
_____base _____clay
_____gravel _____loam _____ sand __√__N/A

What is the prefered wind level?

Preferred wind levels _____high _____medium
_____ low __√__ N/A

Other Unique Preferences: This species prefers lots of space, away from human development. Prefers meadows and open forested areas.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it lives in?

1. This species has fine under fur with dense, coarse, long guard hairs over top.

2. This species is inactive during winter when no urination, feeding or defecation occurs.

3. This species has long claws and large shoulder muscles (with obvious shoulder hump) that help in the digging of soil and pulling apart of logs, while in the search of food.

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species primarily depends on vegetation (forbs, grasses, berries) as its food source. This species is also an opportunistic carnivore eating carrion, fish and small ungulates.

water source: This species gets water from rivers, streams, ponds.

space: This species requires a large range (400 - 600 square kilometres) with little human interaction

E: Reproduction

What does this species require to reproduce?

Breeding season is mid-May through mid - June. However, this species does not breed every year. They are usually monogamous. Their litter size is 1-3 young, born in a den during the winter.

F: Shelter

What type(s) of shelter does this species require?

This species has a widely varied habitat and range. It prefers mountains and foothills with a mixture of meadows and open forested areas. It is dependent on a large vegetative cover to provide a food source. This species usually returns to the same den area each winter to sleep and have young. It does not have a daily shelter it regularly returns to.

G: Growth

How does this species change throughout its lifespan?

Life span: 20 -25 years

mortality factors: Other larger species of its kind, humans

average size at maturity: Females weigh between 150 - 200 kg and males weigh between 350 - 500 kg.

H: Human Uses

How is this species impacted (used) by humans?

Some recreational hunting occurs, viewing, some cultures value specific parts of this species to eat.

Appendix E3.1 - Student Worksheet

The "Nature" of Science:

Unknown Species Card
Species Card: **2**

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species 1" sheet.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

_____ producer
__√__ consumer:
_____herbivore
_____carnivore
__√__ omnivore
_____ decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?
Temperature Range: Not an issue except in extreme cold.

What is the preferred temperature (degrees Celsius) this species likes to live in?
Preferred Temperature Range: not an issue except in extreme cold

What is the sunlight level and intensity this species prefers?
Preferred light levels _____high _____medium _____ low __√__N/A

What is the preferred moisture level this species likes in its ecosystem?
Preferred moisture levels _____high _____medium _____ low __√__ N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.
Preferred soil type _____acidic _____neutral _____base _____clay _____*gravel* _____*loam* _____ *sand* __√__*N/A*

What is the prefered wind level?
Preferred wind levels _____high _____medium _____low __√__N/A

Other unique preferences: Prefers to travel in large groups.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it live in?

1. This species has hollow otter hairs with thick under fur beneath.

2. This species moves to south / southwest facing slopes in winter to take advantage of solar heat and Chinooks winds.

3. This species has long narrow legs make allow for fast travel and easy movement through deep snow.

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species eats a wide variety of vegetation including aspen poplar and grasses.

water source: This species gets water from rivers, streams, ponds and snow.

space: This species requires a range of about 100 square kilometres that contains open deciduous forests and grasslands. This species quite tolerant of human interaction and intrusion into their range.

E: Reproduction

What does this species require to reproduce?

Breeding season is November through December (referred to as the rutt). The males are polygamous. Mating pairs usually produce 1 offspring per year, but twinning is not uncommon.

F: Shelter

What type(s) of shelter does this species require?

This species can be found in the Mountain and Foothills habitats. It generally prefers open semi-open deciduous forests. It does not have a regular shelter, instead it moves around a lot in the search for food. It beds down in grassy areas, usually in large groups.

G: Growth

How does this species change throughout its lifespan?

Life span: 10 - 12 years for females and 7 - 8 years for males

mortality factors: Larger predators such as wolves, coyotes or bears and severe winters.

average size at maturity: Females weigh between 50 - 60 kg and males weigh approximately 75 kg.

H: Human Uses

How is this species impacted (used) by humans?

These species are popular for viewing and hunting by humans.

Appendix E3.1 - Student Worksheet

The "Nature" of Science: Unknown Species Card

Species Card: **3**

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species 1" sheet.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

_____producer
__√__consumer:
  _____herbivore
  __√__carnivore
  _____omnivore
_____decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?
Temperature Range: N/A

What is the preferred temperature (degrees Celsius) this species likes to live in?
Preferred Temperature Range: not an issue except in extreme cold

What is the sunlight level and intensity this species prefers?
Preferred light levels _____high _____medium _____low __√__N/A

What is the preferred moisture level this species likes in its ecosystem?
Preferred moisture levels _____high _____medium _____low __√__N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.
Preferred soil type _____acidic _____neutral _____ base _____clay _____ gravel _____ loam _____ sand __√__N/A

What is the prefered wind level?
Preferred wind levels _____high _____medium _____low __√__N/A

Other unique preferences: Prefers to travel in large groups, of related individuals, using this pack mentality to capture food.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it live in?

1. This species has think dense under fur with long coarse guard hairs.

2. This species has large incisor teeth suited to ripping and tearing meat.

3. This species walks digitigrade (only the front part of their foot touches the ground, the back part remains raised off the ground).

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species is an opportunistic carnivore. It's primary food source are ungulates such as deer elk and sheep.

water source: This species gets water from rivers, streams, ponds and snow.

space: This species requires a diverse range of about 500 square, but individual species gave been known to travel more than a thousand kilometres. This species in not very tolerant of human interaction and intrusion into its range.

E: Reproduction

What does this species require to reproduce?

Breeding season is March through April. The gestation period is 63 days. This species usually gives birth to multiple young, in February, in a den. The young remain in the den until spring. The parents are very protective of their offspring. This species has a close family structure with the parents being very involved with raising their offspring.

F: Shelter

What type(s) of shelter does this species require?

This species has a very generalized habitat in Alberta. It can be found in mountain, foothills, boreal forest and some grassland environments. It uses a den only during the birth of its young in the spring time.

G: Growth

How does this species change throughout its lifespan?

Life span: Both females and males live an average of 8-12 years.

mortality factors: This species has no serious predators except humans.

average size at maturity: Both females and males are similar in size and weight. They both average between 130 - 180 cm. in length and weight approximately 45 - 50 kg.

H: Human Uses

How is this species impacted (used) by humans?

These species are subject to some trapping by humans.

Appendix E3.1 - Student Worksheet

The "Nature" of Science: Unknown Species Card

Species Card: **4**

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species 1" sheet.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

_____producer
__√__consumer:
  _____herbivore
  __√__carnivore
  _____omnivore
_____decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?
Temperature Range: not an issue

What is the preferred temperature (degrees Celsius) this species likes to live in?
Preferred Temperature Range: not an issue

What is the sunlight level and intensity this species prefers?
Preferred light levels _____high _____medium _____low __√__N/A

What is the preferred moisture level this species likes in its ecosystem?
Preferred moisture levels _____high _____medium _____ low __√__N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.
Preferred soil type _____acidic _____neutral _____base _____clay _____gravel _____loam _____sand __√__N/A

What is the prefered wind level?
Preferred wind levels _____high _____medium _____low __√__N/A

Other unique preferences: Prefers a permanent mate and they are rarely apart from each other.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it live in?

1. This species has thick dense under fur with long coarse guard hairs.

2. This species has oily guard hairs to assist in waterproofing and warmth.

3. This species has a long sleek body shape that makes them maneuverable on land and in the water. They are very adept hunters.

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species hunts small mammals, fish, invertebrates, amphibians and birds.

water source: This species gets water from rivers, streams, ponds and snow.

space: This species requires a small range of about 10 square kilometres that contains aquatic, and forests ecosystems.

E: Reproduction

What does this species require to reproduce?

Breeding season is February through April.
The gestation period is 51 days. This species usually gives birth to multiple young (average of 4 per year). The young are born hairless and with closed eyes until they are about five weeks old.

F: Shelter

What type(s) of shelter does this species require?

This species prefers a wetland habitat. It uses dens, located close to a body of water, throughout the year.

G: Growth

How does this species change throughout its lifespan?

Life span: Very little is known about the life span of this species. However, there is almost a complete replacement of individual every 3 years.

mortality factors: This species has no serious predators except humans.

average size at maturity: Females reach a mature weight of .7 kg and reach an average length of 460 - 575 cms. Males weigh an average of 1 - 1.5 kg at maturity and reach an average length of 550-700 cm.

H: Human Uses
How is this species impacted (used) by humans?

These species are subject to some trapping by humans.

Appendix E3.1 - Student Worksheet

The "Nature" of Science: Unknown Species Card

Species Card: **5**

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species 1" sheet.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

_____producer
__√__consumer:
  _____herbivore
  _____carnivore
  __√__omnivore
_____decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?
Temperature Range: not an issue

What is the preferred temperature (degrees Celsius) this species likes to live in?
Preferred Temperature Range: not an issue

What is the sunlight level and intensity this species prefers?
Preferred light levels _____high _____medium _____low __√__N/A

What is the preferred moisture level this species likes in its ecosystem?
Preferred moisture levels _____high _____medium _____ low __√__N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.
Preferred soil type _____acidic _____neutral _____base _____clay _____gravel _____loam _____ sand __√__N/A

What is the prefered wind level?
Preferred wind levels _____high _____medium _____low __√__N/A

Other unique preferences:

This species is regarded as aggressive, curious and ferocious. It has poor eyesight, but an excellent sense of smell. It's also an excellent climber, often climbing trees to jump on its prey.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it live in?

1. This species has a strong scent, emitted by an anal gland, it uses to mark its territory and its food.

2. This species is mostly nocturnal.

3. This is the largest species in the weasel family. It has thick, coarse and woolly under fur with long guard hairs.

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species hunts small mammals such as hare, rodents, beaver and squirrels. It's also known to favour carrion and to kill small ungulates.

water source: This species gets water from rivers, streams, ponds and snow.

space: This species is primarily a solitary nomad, and its home range is extensive. Some individuals have been tracked for more than 100 km over the snow. It is active day an night, all year round, often not seeking shelter even in the coldest weather.

E: Reproduction

What does this species require to reproduce?

Breeding season is during the summer months. The gestation period is 7 - 8 months. This species usually gives birth to a litter ranging in number from 1 - 6 offspring. The young are born in a den in February or March.

F: Shelter

What type(s) of shelter does this species require?

This species prefers the boreal forests, but can also be found in the mountains and foothills. In summer this species constructs a rough bed of grass and leaves under a fallen tree, upturned root or rocky crevice. In winter it settles near the trunks of coniferous trees for short time periods.

G: Growth

How does this species change throughout its lifespan?

Life span: Unknown

mortality factors: Other than loss of habitat, this species has no serious threats to its population.

average size at maturity: Both males and females are similar in size and weight, averaging a length of between 650-1000 cm with an average weight of 14 - 28 kg.

H: Human Uses

How is this species impacted (used) by humans?

These species are subject to some minor trapping by humans.

Appendix E3.1 - Student Worksheet

The "Nature" of Science: Unknown Species Card

Species Card: **6**

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species 1" sheet.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

_____producer
__√__consumer:
_____herbivore
__√__ carnivore
_____omnivore
_____decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?
Temperature Range: -3 degrees Celsius to + 30 degrees Celsius

What is the preferred temperature (degrees Celsius) this species likes to live in?
Preferred Temperature Range: 15 - 25 degrees Celsius

*What is the sunlight level and intensity this species prefers?*Preferred light levels __√__high _____medium _____ low _____N/A

What is the preferred moisture level this species likes in its ecosystem?
Preferred moisture levels _____high _____medium __√__low _____N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.
Preferred soil type _____acidic _____neutral _____base _____clay _____gravel _____loam _____ sand __√__N/A

What is the prefered wind level?
Preferred wind levels _____high _____medium _____low __√__N/A

Other unique preferences: This species can be found just about everywhere in Alberta. This species can be found farther north than any other reptile in the northern hemisphere.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it live in?

1. Many individuals of this species get together to hibernate in large numbers during the winter. They gather together in a tight mass, sometimes numbering more than 50 individuals.

2. This species uses it's tongue to focus a highly developed sense of smell.

3. When this species is threatened, it emits a strong musky smell that is unpleasant to its predators.

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species hunts tadpoles, frogs, small rodents, fish, slugs and wasps.

water source: This species requires minimal water and gets what it needs from the food it eats and from rivers, streams and ponds.

space: This species is primarily a grassland an wetland resident. They are wide spread across Alberta and are a misunderstood species.

E: Reproduction

What does this species require to reproduce?

Reproduction occurs in groups. In the spring, just after hibernation, the males group around the females and complete for females in a tight twisted ball. Between 10 and 15 live young are born in May and average 2 cm in length.

F: Shelter

What type(s) of shelter does this species require?

This species prefers environments that contain small bodies of water. While they don't live in the water they frequently hunt in wetland in the search for food. They spend the majority of their time on land living in abandoned rodent burrows, cracks in the earth and between rocks.

G: Growth

How does this species change throughout its lifespan?

Life span: 6 - 10 years

mortality factors: Other than loss of habitat, this species has a number of predators including raptor birds (hawks, falcons, owls) and coyotes.

average size at maturity: Both males and females are similar in size, averaging a length of between 30 and 80 cm.

H: Human Uses

How is this species impacted (used) by humans?

none

Appendix E3.1 - Student Worksheet

The "Nature" of Science: Unknown Species Card

Species Card: 7

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species 1" sheet.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

__√__ producer
_____consumer:
  _____herbivore
  _____carnivore
_____omnivore
_____decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?
Temperature Range: -40 degrees Celsius to + 30 degrees Celsius

Preferred Temperature Range: 5 - 20 degrees Celsius
What is the preferred temperature (degrees Celsius) this species likes to live in?

What is the sunlight level and intensity this species prefers?
Preferred light levels _____high _____medium __√__low _____N/A

What is the preferred moisture level this species likes in its ecosystem?
Preferred moisture levels __√__high _____medium _____low _____N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.
Preferred soil type __√__acidic _____neutral _____base_____ clay _____gravel _____loam _____ sand _____N/A

What is the prefered wind level?
Preferred wind levels _____high _____medium __√__low _____N/A

Other unique preferences: This species can be found just about everywhere in Alberta except the very dry areas on the south eastern art of the province. It is very soft to the touch.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it live in?

1. This species retains large amounts of water for use during dry periods.

2. This species is tolerant of calcium rich soils.

3. This species grows in concentrated mass "matts"

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species is a producer and is able to use a variety of abiotic features to photosynthesize and produce its own food. It also collects nutrients from the soil.

water source: This species requires large amounts of water and gets it from the soil, precipitation, and an ability to retain moisture when it is available, for use when it is not.

space: This species primarily grows in the boreal forests, but it can also be found in forested foothills and alpine ecosystems. It does not require a lot of space, as it grows in tight compact mounds.

E: Reproduction

What does this species require to reproduce?

Males and female versions of this species produce spores, or create reproductive packets. They also fragment off the parent species and begin growing in a new location.

F: Shelter

What type(s) of shelter does this species require?

This species lives in shady areas along streams, springs seeps and bogs. It can also be found around the base of moisture loving trees.

G: Growth

How does this species change throughout its lifespan?

Life span: unlimited - one layer grows over the other

mortality factors: excessive dry conditions

average size at maturity: 10 - 20 cm.

H: Human Uses

How is this species impacted (used) by humans?

Humans use this species as material for landscapes and other products that require absorption properties.

Appendix E3.1 - Student Worksheet

The "Nature" of Science
Unknown Species Card
Species Card: 8

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species 1" sheet.

A: Energy Role

__√__producer
_____consumer:
  _____herbivore
  _____carnivore
_____omnivore
_____decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?
Temperature Range: -40 degrees Celsius to + 35 degrees Celsius

What is the preferred temperature (degrees Celsius) this species likes to live in?
Preferred Temperature Range: 10 - 20 degrees Celsius

What is the sunlight level and intensity this species prefers?
Preferred light levels __√__high _____medium _____low _____N/A

What is the preferred moisture level this species likes in its ecosystem?
Preferred moisture levels_____high_____ medium __√__ low _____ N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.
Preferred soil type __√__ acidic _____ neutral _____ base _____ clay __√__ gravel _____ loam _____ sand _____ N/A

What is the prefered wind level?
Preferred wind levels __√__high _____medium _____low _____N/A

Other unique preferences: This species retains is shape, colour and foliage for the entire year. It has small blue berries that are not edible by humans.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it live in?

1. This species grows low to the ground to protect itself from winds and heavy snowfall.

2. This species has dry scale-like leave to assist with reducing moisture loss.

3. This species has a strong sweet scent that many animals, especially birds, find attractive.

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species is a producer and is able to use a variety of abiotic features to photosynthesize and produce its own food. It also collects nutrients from the soil.

water source: This species requires limited amounts of water and gets it from the soil and precipitation.

space: This species primarily grows in the boreal forests, but it can also be found foothills, grassland and alpine ecosystems. It does not require a lot of space, as it grows in tight compact groups.

E: Reproduction

What does this species require to reproduce?

Males and female versions of this species produce "cones" that grow off the same plant. This species also produces dark blue berries which each contain 2 to 6 seeds.

F: Shelter

What type(s) of shelter does this species require?

This species lives in dry, rocky, open sites.

G: Growth

How does this species change throughout its lifespan?

Life span: unlimited as long as its growing needs are satisfied.

mortality factors: flooding

average size at maturity: 15 - 30 cm.

H: Human Uses

How is this species impacted (used) by humans?

Humans use this species in a variety of ways:
- the branches are used as a smudge to repel insects,
- the berries and branches are used by native people in religious ceremonies
- the plants are cultured for growth in gardens and parks

Appendix E3.1 - Student Worksheet

The "Nature" of Science
Unknown Species Card
Species Card: **9**

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species 1" sheet.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

__√__ producer
_____consumer:
  _____herbivore
  _____carnivore
_____omnivore
_____decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?
Temperature Range: -40 degrees Celsius to + 35 degrees Celsius

What is the preferred temperature (degrees Celsius) this species likes to live in?
Preferred Temperature Range: 15 - 35 degrees Celsius

What is the sunlight level and intensity this species prefers?
Preferred light levels__√__high _____medium
_____low _____N/A

What is the preferred moisture level this species likes in its ecosystem?
Preferred moisture levels _____high
_____medium __√__low _____N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.
Preferred soil type _____acidic __√__neutral
_____base __√__clay
__√__ gravel _____loam __√__ sand _____N/A

What is the prefered wind level?
Preferred wind levels _____high __√__medium
_____low _____N/A

Other unique preferences: This species is a solitary perrenial herb with leaves that alternate, are pale green and stalked.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it live in?

1. This species has a deep woody root system that anchors the plant in windy conditions, effectively gathers water and stores energy over the winter to grow a new plant in spring

2. This species goes dormant in the winter, losing its leaves in the fall to avoid excess water

3. This species has a strong sweet scent that many animals, especially insects, find attractive. Humans however, find this smell a source of allergy irritation and hay fever.

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species is a producer and is able to use a variety of abiotic features to photosynthesize and produce its own food. It also collects nutrients from the soil.

water source: This species requires limited amounts of water and gets it from the soil and precipitation.

space: This species primarily grows in dry sunny grassland areas and along road sides.

E: Reproduction

What does this species require to reproduce?

In August and September the plant produces large bright yellow pyramid shaped flowers (about 8-10 cm tall) that must be pollinated.

F: Shelter

What type(s) of shelter does this species require?

This species lives in dry, arid, open sites.

G: Growth

How does this species change throughout its lifespan?

Life span: unlimited as long as its growing needs are satisfied.

mortality factors: flooding

average size at maturity: 20 - 60 cm.

H: Human Uses

How is this species impacted (used) by humans?

none

Appendix E3.1 - Student Worksheet

The "Nature" of Science: Unknown Species Card

Species Card: **10**

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species 1" sheet.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

_____producer
__√__consumer:
  _____herbivore
  __√__carnivore
  _____omnivore
_____decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?
Temperature Range: -40 degrees Celsius to + 35 degrees Celsius

What is the preferred temperature (degrees Celsius) this species likes to live in?
Preferred Temperature Range: 15 - 35 degrees Celsius

What is the sunlight level and intensity this species prefers?
Preferred light levels _____high _____medium __√__low _____N/A

What is the preferred moisture level this species likes in its ecosystem?
Preferred moisture levels _____high _____medium __√__ low _____N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.
Preferred soil type _____acidic __√__neutral _____base __√__clay __√__gravel _____loam __√__sand _____N/A

What is the prefered wind level?
Preferred wind level _____high __√__medium _____low _____N/A

Other unique preferences: This species is a year round resident of Alberta. It has a small local range and uses old pileated woodpecker holes as their preferred residence. They get their name from the sound they make, which sounds like a saw being sharpened with a file.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it live in?

1. This species has an extra set of feathers that allow it fly silently enabling it to sneak up on prey.

2. This species has an overly large head for the size of its body. It has a dished shaped face that helps if collect sounds
3. This species has large eyes that are night adapted for hunting.

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species hunts at night for mice, squirrels, shrews, bats, and other small mammals.

water source: This species has no unique water requirements.

space: This species has a small range: living, feeding and finding a mate all with a few square kilometres. It lives in vacated tree cavities located between 4.3 m and 18 m above the ground.

E: Reproduction

What does this species require to reproduce?

This species mates and lays between 4 and 7 eggs each spring in a nest cavity insulated with down. After a 1 month incubation period the newborn spend another month developing feathers and eyesight before they leave the nest. Both parents are involved in raising the young.

F: Shelter

What type(s) of shelter does this species require?

This species lives in old vacated cavities in trees. These holes are usually created by woodpeckers. Once they have established a nest they will not leave it, even when challenged or threatened.

G: Growth

How does this species change throughout its lifespan?

Life span: unknown

mortality factors: habitat loss contributes to a small mortality factor

average size at maturity: 18 - 20 cm tall.

H: Human Uses

How is this species impacted (used) by humans?

none

Appendix E3.1 - Student Worksheet

The "Nature" of Science: Unknown Species Card

Species Card: **11**

Use the information on this card, together with your field study notes, to answer the questions on the "Unknown Species" sheet.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

__√__producer
_____consumer:
  _____herbivore
  _____carnivore
  _____omnivore
_____decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?
Temperature Range: -40 degrees Celsius to + 35 degrees Celsius

What is the preferred temperature (degrees Celsius) this species likes to live in?
Preferred Temperature Range: 10 - 30 degrees Celsius

What is the sunlight level and intensity this species prefers?
Preferred light levels __√__high _____medium _____low _____N/A

What is the preferred moisture level this species likes in its ecosystem?
Preferred moisture levels _____high __√__medium _____low _____N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.
Preferred soil type _____acidic __√__neutral _____base __√__clay __√__gravel _____loam __√__sand _____N/A

What is the prefered wind level?
Preferred wind levels _____high __√__medium _____low _____N/A

Other unique preferences: This species is a solitary perennial shrub with leaves that alternate, are dark green, compound (with 5-7 leaflets). Its fruit are small red berries, referred to as "hips". This species is the floral emblem of Alberta.

C: Special Adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive in the ecosystem it live in?

1. This species has a woody stems that are covered with small prickles that defend the plant against insect invasion of browsing by herbivores that live in their areas.

2. This species goes dormant in the winter, losing its leaves in the fall to avoid excess water

3. This species has a stout bushy growth habit.

D: Biotic Needs

What does this species need to survive?

energy (food) source: This species is a producer and is able to use a variety of abiotic features to photosynthesize and produce its own food. It also collects nutrients from the soil.

water source: This species requires limited amounts of water and gets it from the soil and precipitation.

space: This species primarily grows in open aspen groves, prairie ecosystems, coulees, along roadsides and along the edges of wooded areas.

E: Reproduction

What does this species require to reproduce?

The parent plant must be pollinated. This species sends out underground rhizomes that periodically surface to produce a new individual of this species.

F: Shelter

What type(s) of shelter does this species require?

This species lives in dry, arid, open sites.

G: Growth

How does this species change throughout its lifespan?

Life span: unlimited as long as its growing needs are satisfied.

mortality factors: none

average size at maturity: 100 - 120 cm.

H: Human Uses

How is this species impacted (used) by humans?

none

Appendix E4 - Student Worksheet

The "Nature"of Science: Unknown Species -1 Who Am I?

Name: _____

Date: _____

Use the information on the Unknown Species Card and the information you collected on the field study to answer the following questions:

Species Card	Name of Species Reasons for Decision	Ecosystem It Would Live In Reasons for Decision
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Appendix E5 - Student Worksheet

The "Nature" of Science: Unknown Species Card

Developed by: _____

_____

Instructions:

1. Using the information you have gathered thus far, create an unknown species card by completing this sheet. **DO NOT PLACE THE NAME OF THE UNKNOWN SPECIES ON THIS SHEET.**
2. Hand this completed sheet into the teacher.
3. Collect an Unknown Species 2 card completed by a fellow student and determine the name of the species and the ecosystem it could live in.

A: Energy Role

What role does this species serve in the ecosystem? Check as many as required.

_____producer
_____consumer:
  _____herbivore
  _____carnivore
  _____omnivore
_____decomposer

B: Abiotic Needs

What extreme temperatures (degrees Celsius) does this species live within?

Temperature Range:

_____

_____

_____

What is the preferred temperature (degrees Celsius) this species likes to live in?

Preferred Temperature Range:

_____

_____

_____

What is the sunlight level and intensity this species prefers?

Preferred light levels _____high _____medium _____ low _____ N/A

What is the preferred moisture level this species likes in its ecosystem?

Preferred moisture levels _____high _____medium _____low _____ N/A

What types of soil does this species prefer in its ecosystem? Check as many as required.

Preferred soil type _____acidic _____neutral _____base _____clay _____gravel _____loam _____ sand _____N/A

What is the prefered wind level?

Preferred wind levels _____high _____medium _____low _____N/A

Other unique preferences: _____

_____

_____

C: Special adaptations

What special talents, abilities, traits or behaviours does this species have that helps it survive?

1. _____
2. _____
3. _____

D: Biotic Needs

What does this species need to survive?

energy (food) source: _____

water source: _____

space: _____

E: Reproduction

What does this species require to reproduce?

F: Shelter

What type(s) of shelter does this species require?

G: Growth

How does this species change throughout its lifespan?

Life span _____

mortality factors: _____

average size at maturity: _____

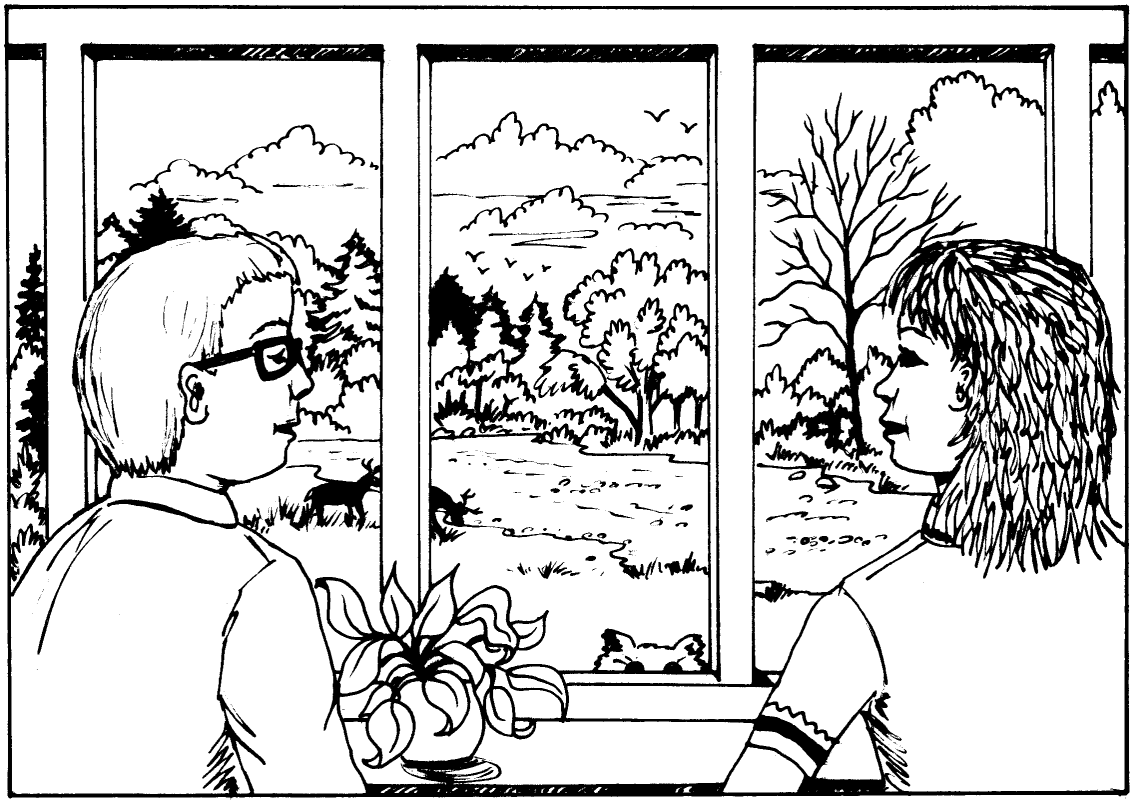
H: Human Uses

How is this species impacted (used) by humans?

The "Nature" of Science
Unknown Species
Ecosystem Web

Teacher Instructions

1. Photocopy 6 copies of the sheet (Appendix E6.1) containing the 6 shortened blank "Unknown Species" cards for each student.
2. Circulate these 6 blank cards and a blank 11" x 17" piece of paper to each student.
3. Ask the students to designate 2 producers, 2 consumers and 2 decomposers from one of the ecosystem they explored on the field study.
4. Complete a shortened "Unknown Species" card for each of the 6 members selected for the "Unknown Species Ecosystem Web" they will create. Arrange these 6 sheets around an 11" x 17" sheet of paper. **BE SURE TO LEAVE THE NAMES OF THE SPECIES AND THE ECOSYSTEM <u>OFF</u> EACH CARD.**
5. Collect and circulate these "Unknown Species Ecosystem Web" sheets that have been generated by students, randomly to other students in the classroom.
6. Instruct the students to use research information and their field study data to determine the name of each of the unknown species in their web, identify the ecosystem and draw lines that connect these species indicating how these species are inter-related in the natural world. The result is a partial food web that demonstrates how these species are connected to one another.



Appendix E6.1 - Student Worksheet

The "Nature" of Science: Unknown Species Ecosystem Web Student Instructions

Part 1:

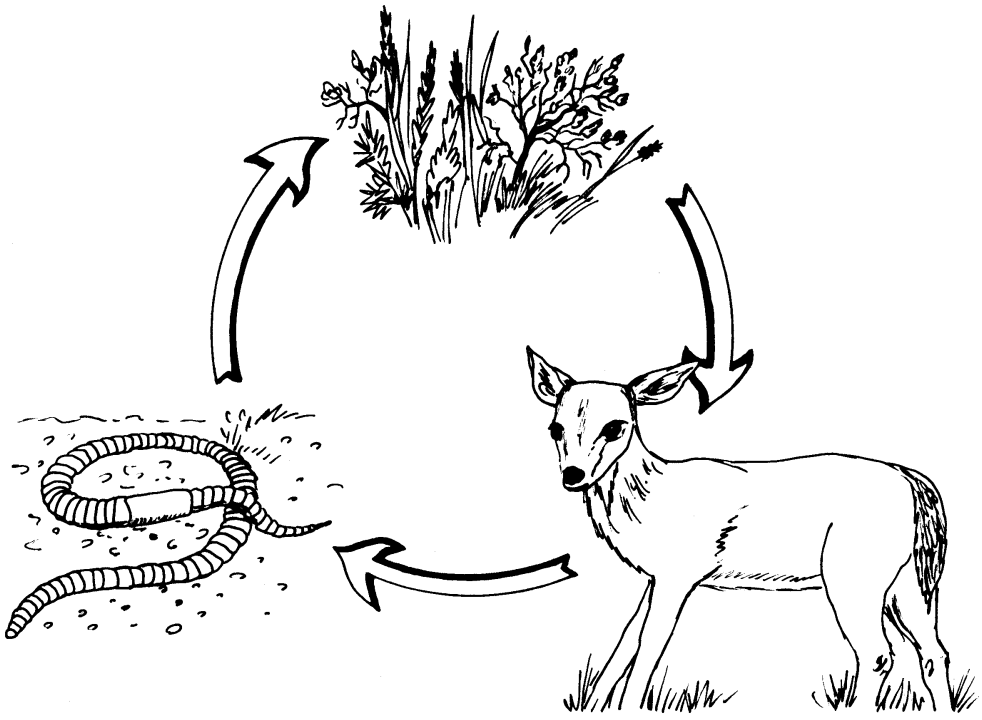
Develop an Unknown Species Ecosystem web by completing the following:

1. Select 2 producers, 2 consumers and 2 decomposers from any ecosystem visited on the field study.
2. Complete an "Unknown Species" card, using the information you gathered on the field study for each of these species. Be sure to **NOT** add the names of each species or the ecosystem they exist in.
3. Arrange the 6 "Unknown Species" card randomly in a circle on an 11" x 17" sheet of paper.
4. Write your name as the developer of this Unknown Species Ecosystem Web.
5. Share your web with other students.

Part 2:

When you receive an Unknown Species Ecosystem Web someone else developed, complete the following.

1. Use the information you gathered on the field study to determine what each of the species in the Unknown Species Ecosystem Web are.
2. Name the ecosystems and then connect the 6 species with arrows to indicate how energy flows through this mini food web.



Appendix E6.1 - Student Worksheet

The "Nature" of Science

Unknown Species: _____

Developed by: _____

A: Energy Role: _____

B: Abiotic Needs

Temperature Range _____

Preferred Temperature Range: _____

Preferred light levels
_____high _____medium _____low _____N/A

Preferred moisture levels
_____high _____medium _____low _____N/A

Preferred soil type
_____acidic _____neutral _____base _____clay
_____gravel _____loam _____sand _____N/A

Preferred wind levels
_____high _____medium _____low _____N/A

Other unique preferences: _____

C: Special Adaptations

1. _____

2. _____

D: Biotic Needs

energy (food) source: _____

water source: _____

space: _____

E: Reproduction

F: Shelter

G: Growth

Life span: _____

mortality factors: _____

average size at maturity: _____

H: Human Uses

The "Nature" of Science:

Plants And Animals Of Alberta's Natural Regions

Natural Region	Mammals and Birds	Plants
Aspen Parkland 12% of the province	Richardson's ground squirrel, snowshoe hare, coyote, fox, deer, weasel, beaver, meadow vole, deer mouse, Swainson's hawk, ruffed grouse, saw-whet owl, magpie, sparrow, warbler, chickadee, northern oriole	aspen, willow, saskatoon, prickly rose, fescue grass, sedges, dogwood, prairie rose, yarrow, False Solomon's seal, goldenrod, wood lily, milk vetch, prairie crocus, moss, bracket fungus, saskatoon, cranberry
Canadian Shield 2.7% of the province	moose, beaver, mink, lynx, hare, black bear, bald eagle, osprey, peregrine falcon, sandhill crane, arctic and caspian tern, gray jay, chickadee, robin, loon	jack pine, white and black spruce, tamarack, bearberry, saskatoon, cranberry, bunchberry, Labrador tea, peatmoss, swamp laurel, water sedge, reindeer lichen
Foothills 12.9% of the province	grizzly and black bear, cougar, coyote, lynx, elk, moose, mule deer, fox, marten, red squirrel, porcupine, snowshoe hare, beaver, marsh hawk, peregrine falcon, grouse, gray jay, pine siskin, sparrow, flicker	lodgepole pine, white and black spruce, balsam fir, aspen, balsam poplar, birch, willow, buffaloberry, yarrow, fireweed, raspberry, bunchberry
Grassland 13.7% of province	pronghorn antelope, deer, badger, skunk, coyote, weasel, rabbit, Richardson ground squirrel, muskrat, kangaroo rat, heron, burrowing owl, grouse, duck, praire falcon, peregrine falcon, swallow, garter snake, toad, lizard	cottonwood, balsam poplar, sedges, fescue grass, sagebrush, prairie rose, prickly pear cactus, praire crocus, praire clover, creeping juniper, yucca, buffaloberry, cattail, bulrush
Northern Forest (Boreal Forest) 51.9% of the province	moose beaver, muskrat, deer, otter, mink, wolf, lynx, black and grizzly bear, squirrel, fox, snowshoe hare, vole, loon, osprey, grouse, gull, geese, woodpecker, raven, western tanager, chickadee, warbler, wood frog	white and black spruce, jack pine, aspen, balsam poplar birch, larch, willows, dogwood, fireweed, cranberry, saskatoon, bunchberry, yellow pond lily, spagnum moss, lichen, cattail, bulrush, sedges, horsetail
Rocky Mountains 6.8% of the province	grizzly and black, elk, wolf, coyote, wolverine, pika, mountain goat, bighorn sheep, marmot, Columbian ground squirrel, raven, dipper, ptarmigan, Steller's jay, sparrow	grasses, Douglas fir, limber pine, aspen, lodgepole pine, Engelmann spruce, willow, bearberry, subalpine fir, lichen, moss campion, cinquefoil, mountain aven, paintbrush

Appendix E8 - Student Worksheet

The "Nature" of Science Assessment Rubric For Cooperative Group Work

Name:

_____

Date:

_____

Review the criteria in the list below. Evaluate your role, as an active group member, in completing this project by circling the appropriate number, using the scale provided, that describes your contributions to the efforts of the group. Add areas that reflect your groups personal approach to this project. These could include criteria about your project format, topic of study, a specific focus of the field study that is unique to your group, or other ways your project will be different.

4: almost always 3: often 2: sometimes 1: rarely 0: never.

A. Group Participation

1. Participated in group discussions and activities
   4 3 2 1 0

2. Did an appropriate share of the work
   4 3 2 1 0

3. Did not dominate the group
   4 3 2 1 0

4. Did not interrupt others in their work
   4 3 2 1 0

B. Stayed On Topic

1. Paid attention and listened to what was said and done
   4 3 2 1 0

2. Made comments aimed at staying on topic
   4 3 2 1 0

C. Offered Useful Ideas

1. Gave useful ideas and suggestions to the group
   4 3 2 1 0

2. Offered useful criticism and comments
   4 3 2 1 0

3. Positively influenced the group's decisions and plans
   4 3 2 1 0

4. Recognized and used personal strengths
   4 3 2 1 0

D. Consideration

1. Made encouraging remarks about the group and their ideas
   4 3 2 1 0

2. Tried to get the group working together to reach agreement
   4 3 2 1 0

3. Respectfully and seriously considered the ideas of others
   4 3 2 1 0

E. Unique Group Aspects of The Project

Add your own ideas.

1. _____
   4 3 2 1 0

2. _____
   4 3 2 1 0

3. _____
   4 3 2 1 0

4. _____
   4 3 2 1 0

Total Score: _____/82

Appendix E9 - Student Worksheet

The "Nature" of Science Post-Test

Name: _____

Date: _____ Score: _____ /50

Instructions:

Read each questions carefully. Answer each question as completely as possible. Note the mark value for each question and ensure that your answers are complete and easy to read. Be sure to proof read and check your answers once you are complete.

Part One: Matching (10 marks)

Match the vocabulary to the correct definition below:

____abiotic factor	A. an organisms surroundings
____biotic factor	B. a small sampling area used for estimating populations of small organisms
____quadrat	C. the gentleness or steepness of a study area
____slope	D. an ecosystem characterized by acidic soil and spruce trees
____producer	E. a network of interactions linking living and non-living things
____consumer	F. an ecosystem characterized by deciduous trees including poplar and many species of herbs.
____aspen woodland	G. the living parts of an organism's environment
____boreal forest	H. the non-living parts of an organisms environment.
____ecosystem	I. an organism that obtains its food by eating another organism
____environment	J. an organism that can produce its own food from materials in the abiotic parts of the environment.

Part 2: Short Answer (32 marks)

Respond to the following question in complete sentences. Draw on your experiences during the field study to support your conclusions.

1. The soil under conifers is typically acidic.

   a. What observations did you make on the field study that would have led to this conclusion? (1 mark)

   b. Describe how you would measure soil acidity in the field. (1 mark)

   c. On the pH scale below, locate the approximate pH of acidic soil. (1 mark)

pH Scale

1 2 3 4 5 6 7 8 9 10 11 12 13 14

2. Explain how objects affect the wind velocity in an area. Use specific observations to support you conclusion. (4 marks)

3. Provide 2 reasons why it might be important to know how many plants and animals there are in an ecosystem. (4 marks)

4. Define the concept of a "protected area". Provide an example of a protected area and explain why it has been given "protected area" status. (5 marks)

5. List 3 abiotic factors. Explain how they might determine the biotic factors present in an ecosystem. Be specific. (4 marks)

6. Your ecosystem has an approximate area of 100m x 200m. You do a 1 square metre quadrat and find 4 aspen poplar seedlings in this area. How many would you expect to find in the whole ecosystem? (4 marks)

7. Why might you choose to do an line transect rather than a quadrat to determine the relative frequency of white spruce in a boreal forest ecosystem. (4 marks)

8. Define "aspect" and explain why "aspect" is an important characteristic to measure when you are defining an ecosystem. (4 marks)

Part 3: Applying What You Know (8 marks)

Using 6 organisms identified in one of the three ecosystems you studied on your field study, draw a food web. Identify the producers, consumers, and decomposers in your food web and take care to mark the energy flow through the ecosystem with directional arrows. Introduce a species that would be unlikely to survive in this ecosystem (eg. camel). Using your food web and your understanding of the abiotic factors and the human influences present, explain why this species is unlikely to survive.

The "Nature" of Science: Post-Test Answers Teacher's Guide

Part One: Matching (10 marks)

Match the vocabulary to the correct definition below:

__A__ abiotic factor	A. an organisms surroundings
__G__ biotic factor	B. a small sampling area used for estimating populations of small organisms
__B__ quadrat	C. the gentleness or steepness of a study area
__C__ slope	D. an ecosystem characterized by acidic soil and spruce trees
__J__ producer	E. a network of interactions linking living and non-living things
__I__ consumer	F. an ecosystem characterized by deciduous trees including poplar and many species of herbs.
__F__ aspen woodland	G. the living parts of an organism's environment
__D__ boreal forest	H. the non-living parts of an organisms environment.
__E__ ecosystem	I. an organism that obtains its food by eating another organism
__A__ environment	J. an organism that can produce its own food from materials in the abiotic parts of the environment.

Part 2: Short Answer (32 marks)

Respond to the following question in complete sentences. Draw on your experiences during the field study to support your conclusions.

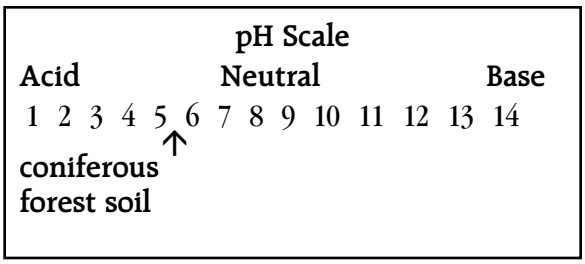
1. The soil under conifers is typically acidic.
   a. What observations did you make on the field study that would have led to this conclusion? (1 mark)

   a. A lack of vegetation under spruce trees produces very little duff (decaying plant material). This together with the presence of coniferous tree needles and dark soil all contribute to creating acidic soil.

   b. Describe how you would measure soil acidity in the field. (1 mark)

   b. pH can be tested in a number of ways: using litmus paper, placing a small sample into a pH soil tester and adding chemicals, or using a commercial meter device that uses a wand to measure pH. The sample changes colour. This colour indicates its level of acidity.

c. On the pH scale below, locate the approximate pH of acidic soil. (1 mark)



2. Explain how objects affect the wind velocity in an area. Use specific observations to support you conclusion. (4 marks)
Large objects such as trees, clusters of trees or large boulders, provide shelter from the wind. The topography of an area will often provide shelter through valleys and depressions and cliffs will channel winds along them.

3. Provide 2 reasons why it might be important to know how many plants and animals there are in an ecosystem. (4 marks)

1. *To monitor changes in the ecosystem, over time, as a result of a variety of factors.*
2. *To get a sense of the relationship(s) between all organisms within the ecosystem.*
3. *Monitoring the number (population) of organisms in an ecosystem provide an opportunity to infer about its relative health over time.*
4. *Monitoring the populations of an ecosystem provide information about migratory species.*

4. Define the concept of a "protected area". Provide an example of a protected area and explain why it has been given "protected area" status. (5 marks)
There are a variety of types of protected areas. They include: ecological reserves, wilderness areas, wildlands, provincial parks, natural areas, recreational areas, wayside and access sites. While all of these have "protected" status, the level of protection varies. Ecological areas are "more" protected than wayside access areas because fewer land-uses are permitted in ecological reserves.

It's a protected area because it contains a wide variety of ecosystems, it's home to a number of endangered species and it's a popular migratory "touch down" spot or birds. Within its boundaries hunting, development and camping are not permitted, but recreational activities, that don't damage the natural areas are permitted.

5. List 3 abiotic factors. Explain how they might determine the biotic factors present in an ecosystem. Be specific. (4 marks)
Abiotic factors include such things are temperature, elevation, aspect, light, heat, soil, winds, etc. These all interact to create a variety of environmental conditions. Temperature: the number of frost free days in a year allow for some species to survive that would not live in areas that had less frost free days. Light: the hours of daily sunlight satisfy specific needs for some flora and fauna. If a specific organisms needs for sunlight are not met in any given ecosystem, that organism will not survive there. Wind: plant organisms that have weak or surface root systems will not survive in an area that has strong prevailing winds.

6. Your ecosystem has an approximate area of 100m x 200m. You do a 1 square metre quadrat and find 4 aspen poplar seedlings in this area. How many would you expect to find in the whole ecosystem? (4 marks)

total area =
200m x 100m = 20000m squared
= 2 km squared

$$\frac{4 \text{ aspen}}{1 \text{ m squared}} \qquad \frac{n}{20000 \text{ m squared}}$$

= 80,000 seedlings in the ecosystem

7. Why might you choose to do an line transect rather than a quadrat to determine the relative frequency of white spruce in a boreal forest ecosystem. (4 marks)
Line transects require less time to complete. They are useful for quickly monitoring a cross section on an entire area or ecosystem on a regular basis. Weekly walks of a transect provide repeated and relatively detailed data on the changes within an area. Transects are sometimes used in areas that are too dense for effective quadrat exploration.

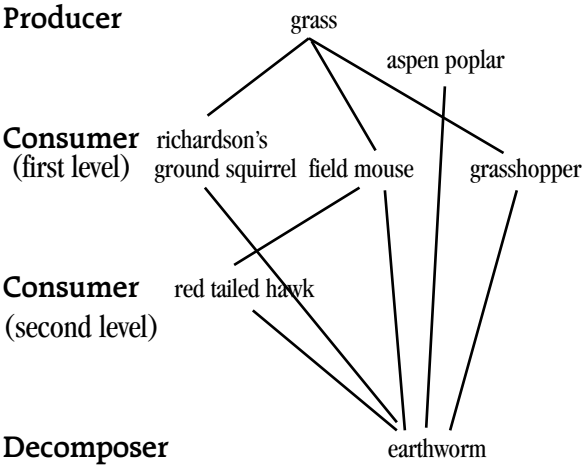
8. Define "aspect" and explain why "aspect" is an important characteristic to measure when you are defining an ecosystem. (4 marks)
Aspect refers to an ecosystems orientation to the sun (abiotic factors of heat and light are affected). A slope with a south aspect (facing south) has more heat and light than a north aspect, which is a slope facing north. Aspect can also refer to the angle of the slope. A south facing slope of 10 degrees receives less heat and light than a south facing slope with an angle of 40 degrees.

Part 3: Applying What You Know (8 marks)

Using 6 organisms identified in one of the three ecosystems you studied on your field study, draw a food web. Identify the producers, consumers, and decomposers in your food web and take care to mark the energy flow through the ecosystem with directional arrows. Introduce a species that would be unlikely to survive in this ecosystem (eg. camel). Using your food web and your understanding of the abiotic factors and the human influences present, explain why this species is unlikely to survive.

Grassland Ecosystem

grass / aspen poplar / grasshopper / field mouse / richardson's ground squirrel / red tailed hawk / earthworm.



A camel would not be able to survive in this ecosystem for several reasons:
temperature: *this ecosystem has a rather low average annual temperature for a camel.*
size: *a camel is too large to survive in this ecosystem. There is not enough food for the camel to eat.*
food: *the available food sources are not what camels eat.*
vegetation: *shrubs and trees are not suitable vegetation for camels to travel through*
predators: *there are no natural predators to regulate a camel population.*