Adult Basic Education

Science

Science 2100A
Ecosystems

Curriculum Guide

Prerequisites: None

Credit Value: 1

<u>Science Courses [General College Profile]</u>

Science 2100A
Science 2100B
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Science 3101
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To the Instructor

I. <u>Introduction to Science 2100A</u>

This course is intended to help students acquire knowledge about ecosystems that will allow them to become better informed participants and decision makers for the future of the environment.

This course is divided into three units. The first unit, *Diversity in Ecosystems*, will introduce ecological concepts as well as food chains and webs. The idea of biodiversity will be discussed, showing how ecosystems are rich in biotic factors and that biotic factors are linked to abiotic factors. It will emphasize how biodiversity is continuously threatened.

The second unit, *Change and Stability in Ecosystems*, will examine the flow of energy through ecosystems and in doing so will explore food chains and webs in more detail. Important geochemical cycles such as the carbon and nitrogen cycles and their role in shaping ecosystems will be studied. The idea of how humans are affecting and interfering with these cycles and thus interfering with ecosystems through the use of pesticides and other activities will be explored.

The third unit, *Populations*, will examine ecological populations. Population growth and its relationship with and impact on the environment will be introduced.

This is a 1 credit course and, along with Science 2100B, is **a pre-requisite for Science 2100C.** Science 2100A, B, and C are equivalent to Science 2200 in the current high school program.

The textbook for this course is *Nelson Science 10: Concepts and Connections;* Nelson Thomson Learning; 2002.

***Note** that students are **not** permitted to receive credit for both the ABE course **Biology 1101** (or Science 1206 in the current high school program) and **Science 2100A**, since there is too much overlap of content.

To the Instructor

II. Curriculum Guides

Each new ABE Science course has a Curriculum Guide for the instructor and a Study Guide for the student. The Curriculum Guide includes the specific curriculum outcomes for the course. Suggestions for teaching, learning, and assessment are provided to support student achievement of the outcomes.

Each course is divided into units. Each unit comprises a **two-page layout of four columns** as illustrated in the figure below. In some cases the four-column spread continues to the next two-page layout.

Curriculum Guide Organization:
The Two-Page, Four-Column Spread

Unit Number - Unit Title	
Outcomes Specific curriculum outcomes for the unit.	**Notes for Teaching and Learning** Suggested activities, elaboration of outcomes, and background information.

Unit Number - Unit Title	
Suggestions for Assessment Suggestions for assessing students' achievement of outcomes.	**Resources** Authorized and recommended resources that address outcomes.

III. Study Guides

The Study Guide provides the student with the name of the text(s) required for the course and specifies the sections and pages that the student will need to refer to in order to complete the required work for the course. It guides the student through the course by assigning relevant reading and providing questions and/or assigning questions from the text or some other resource. Sometimes it also provides important points for students to note. (See the *To the Student* section of the Study Guide for a more detailed explanation of the use of the Study Guides.) The Study Guides are designed to give students some degree of independence in their work. Instructors should note, however, that there is much material in the Curriculum Guides in the *Notes for Teaching and Learning* and *Suggestions for Assessment* columns that is not included in the Study Guide and instructors will need to review this information and decide how to include it.

IV. <u>Resources</u>

Essential Resources

Nelson Science 10: Concepts and Connections; Nelson Thomson Learning;2002

Nelson Science 10: Concepts and Connections - Teacher's Resource; Nelson Thomson Learning; 2002

Recommended Resources

Nelson Science 10: Concepts and Connections - Student Record of Learning;Nelson Thomson Learning; 2002

Science 2200 Curriculum Guide

http://www.ed.gov.nl.ca/edu/sp/sh/sci/science2200jun04.pdf

*Science 10 Teacher's Resource***,** Applied Supplement; Nelson Thomson Learning; 2001.

Nelson Publishing Web Site:

http://www.science.nelson.com

Other Resources

Center for Distance Learning and Innovation:

http://www.cdli.ca/

To the Instructor

V. Recommended Evaluation

Written Notes	10%
Labs/Assignments	20%
Test(s)	20%
Final Exam *(entire course)*	50%
	100%

Ecosystems

Unit 1 - Diversity in Ecosystems

Outcomes

1.1 Recognize the variety of ecosystems.

- 1.1.1 Define ecosystem.
- 1.1.2 Identify the factors that allow for variation in ecosystems.

1.2 Describe food chains.

- 1.2.1 Define food chain.
- 1.2.2 Define and classify organisms as producer, consumer, herbivore, carnivore, decomposer.

1.3 Explain biotic and abiotic factors that keep natural populations in equilibrium.

- 1.3.1 Define ecology, habitat, population, community, biodiversity.
- 1.3.2 Define and identify biotic factors.
- 1.3.3 Define and identify abiotic factors.
- 1.3.4 Explain how biotic and abiotic factors affect ecological interactions and the distribution of organisms.

Notes for Teaching and Learning

Students who begin this course soon after completing the regular intermediate program in the school system should have had some exposure to ecology and environmental studies. However, most students starting this course will likely not have prior knowledge upon which to build in these areas. Instructors should not make assumptions about the familiarity of students with many basic ecological and environmental concepts.

Many students will not be familiar with the term ecosystem and it is not defined in the text. However, since they will encounter it at the beginning of this course, students will need to understand what it is. If necessary, instructors could provide extra information in addition to what is in the Study Guide.

Instructors may want to introduce the term sustainability at this point. It will be covered in detail in Science 2100C. Sustainability can be defined as "the ability to meet the needs of the present generation without compromising the ability of future generations to meet their needs".

Section 1.1 of the text introduces (or reviews) the concept of food chains as referred to in Outcome 1.2. Food chains will be covered in more detail later in the course.

Instructors should supplement the examples in the text by providing examples of food chains in this province that students would likely be familiar with. For example: producers - blueberry, birch, moss, lichens, algae, etc.; herbivores - hares (rabbits), moose, caribou; carnivores - fox, mink, seal, owl.

Instructors could give students a copy of Blackline Master (BLM) 1.3a, "*Concepts in Ecology*", for discussion of the relationship between the terms that have been introduced.

Unit 1 - Diversity in Ecosystems

Suggestions for Assessment

If there is a group of students doing this course at the same time, they could be given the opportunity to discuss what they already know using the questions on page 7 of the text as a guideline.

Instructors should assess the student's level of understanding by reading student answers to questions from the Study Guide and providing feedback.

Students will be introduced to many new terms throughout this course. Instructors could suggest that students start a vocabulary list and add to it regularly as they work through the unit. Instructors should ensure that all necessary terms are being added to the student's vocabulary list and provide them with ideas about how to successfully remember definitions.

Students could be asked to identify the various biotic and abiotic factors in the community shown in Figure 1 on page 14 of the text.

BLM 1.3b, *"Ecological Reach For the Top"*, can be used to assess the student's level of understanding of the various concepts presented.

There are many opportunities for research and additional assignments in this course. Instructors should develop and assign work when they feel it is necessary either for review or for extension or enrichment of a particular topic. All assignments should be given a mark that is used as part of the final evaluation for the course.

Resources

Science 10: Concepts and Connections, page 6 - 15.

Science 10: Concepts and Connections, *Teacher's Resource*, pages 1 - 26.

The Center for Distance Learning and Innovation website:
www.cdli.ca

Textbook website:
www.science.melson.com

Website for "*Work the Web*" for students:
www.science.nelson.com/0176120955/default.html

BLM 1.3a, "*Concepts in Ecology*".

BLM 1.3b, "*Ecological Reach for the Top*".

Outcomes

1.4 Describe the classification system for at-risk species.

1.5 Describe the main causes and effects of extinction.

1.6 Evaluate relationships that affect the biodiversity of life within the biosphere.

1.7 Understand that biodiversity loss due to human activities adversely affects ecosystems.

1.8 Analyze the risks to society of a loss of biodiversity.

Notes for Teaching and Learning

As students work through their Science courses, there are many opportunities for links with the English program. For example, students may be interested in doing more research into restoration plans for endangered species. The Extension Activity on pages 12 - 13 in the Student Record of Learning (SRL) could be used to guide their research.

A Newfoundland and Labrador at-risk species such as the pine marten could be researched and the impact of human activities discussed as well.

The assignment for this unit is required. It is designed to cover Outcomes 1.6, 1.7 and 1.8 and reinforces some other outcomes. Instructors could use the assignment included (Appendix A) or develop another assignment to cover these outcomes.

Assignment 1 consists of two parts. Part I asks students to read the article, "*The Diversity of Life*", and answer some questions. Part II asks students to read the article, "*Loss of Biodiversity*", and answer some questions. Students are required to complete both parts of the assignment.

Suggestions for Assessment

Students can use BLM 1.2, *“Classification of At-Risk Species”*, for review.

The assignments given in this course are meant to reinforce some of the concepts covered and to explore them further. Any new material presented in the assignments should not be included for testing purposes. The tests given for the course should only include the material covered by the questions in the Study Guide.

Instructors should assign a mark for the assignment for this unit and use that mark as part of the final evaluation for the course. It is recommended that the marks given for assignments and/or labs comprise 20% of the final mark for the course.

Resources

Appendix A, Assignment 1, Part I, “*The Diversity of Life*”, Part II, “*Loss of Biodiversity”*.

BLM 1.2, “*Classification of At-Risk Species*”.

SRL, pages 12 - 13.

Outcomes

2.1 Describe the use of energy in ecosystems.

2.1.1 Define trophic level.

2.1.2 Define and classify organisms as primary and secondary consumers.

2.1.3 Define food web.

2.1.4 Distinguish between food chain and food web.

2.1.5 Examine the flow of energy in ecosystems using the concept of the energy pyramid.

2.1.6 Explain how humans have changed the flow of energy in ecosystems.

2.2 Illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen and oxygen.

2.2.1 Identify the elements that are common to all living things.

2.2.2 Differentiate between organic and inorganic materials.

2.2.3 Define photosynthesis and cellular respiration.

Notes for Teaching and Learning

Since they may have unusual pyramidal shapes, pyramids of numbers and biomass are not covered in this course. The pyramid of energy is the only one covered.

Instructors should note that the topic of greenhouse gases will be covered in Science 2100C.

Students should understand that the impacts humans have had on energy flows were minimal at first. As the population of humans increased so did their need for more energy (food). This increased the need for land and often resulted in the displacement or complete extinction of other consumers.

Instructors should make sure that students understand that, with the exception of solar energy, all the materials/nutrients we need for sustaining life are present in finite amounts. All nutrients are cycled through systems, changing from one form to another and never leave earth.

Many students will need to be reminded of the concepts of elements and compounds and chemical reactions. They should know that **carbon, oxygen, hydrogen** and **nitrogen** make up the vast majority of living tissue. These four elements are recycled between living organisms and the soil, water, and atmosphere. If recycling of these materials did not occur, life could not exist.

Students generally have difficulty understanding the cycles. Diagrams are often helpful. Blackline Master 1.8, "*The Carbon Cycle*", can be used, since it corresponds to Figure 3 in the text, or instructors may provide a simpler version (such as the one included in Appendix B) of the carbon cycle to emphasize the relationship between photosynthesis and respiration.

Suggestions for Assessment

BLM 1.7b, *"Relationships in Ecosystems"*, can be used to determine students' level of knowledge of food chains and food webs.

Instructors should assess the student's level of understanding by reading student answers to questions from the Study Guide for this unit and providing feedback. It is recommended that this work is assigned a mark of 10% of the final mark for the course.

Instructors should ensure that all necessary terms are being added to the student's vocabulary list.

A review of the key terms and concepts would be useful. Using local organisms as examples to illustrate the concepts would likely make it more memorable for students.

Resources

Science 10: Concepts and Connections, pages 23 - 37.

Science 10: Concepts and Connections, *Teacher's Resource*, pages 35 - 57.

BLM 1.7b, "*Relationships in Ecosystems*".

BLM 1.8, "*The Carbon Cycle*".

Diagram, "*The Cycling of Oxygen and Carbon*", Appendix B.

Outcomes

2.2.4 Explain how photosynthesis and cellular respiration are linked.

2.2.5 Explain the carbon cycle by describing the processes required to cycle carbon from storage to the atmosphere.

2.2.6 Describe how humans have altered the carbon cycle.

2.2.7 Briefly describe the nitrogen cycle in terms of nitrogen fixation and denitrification.

2.2.8 Explain why the nitrogen cycle is important to life on Earth.

2.3 Examine the change of matter in ecosystems using the concept of cycling of matter.

2.4 Describe the mechanisms of bioaccumulation caused by pesticide use and explain its potential impact on the viability and diversity of consumers at all trophic levels.

2.4.1 Define the terms pest and pesticide.

Notes for Teaching and Learning

Students should realize the importance of the nitrogen cycle in the maintenance of life on earth. Nitrogen is found in amino acids, proteins and genetic material. Most of the living tissue in animals is protein (containing oxygen, hydrogen and nitrogen atoms). The chemical processes that occur within the bodies of living things (digestion, growth, reproduction, etc.) are all controlled by special proteins called enzymes. Nitrogen is also a nutrient that plants require.

When studying the nitrogen cycle, students often lose sight of the fact that animals get nitrogen by consuming living and dead organic matter that contains nitrates, i.e. through the food chain.

Instructors could refer to the *Science 10* academic textbook for more complete information on the history of pesticides.

Bioaccumulation will also occur with heavy metals such as mercury and lead. Students may be interested in learning about the effects of mercury or lead poisoning. Minamata disease is a real world example of the effects of lead poisoning. They could research this topic as part of the assignment for this unit.

Students will achieve outcome 2.3 by completing Part I, "*Ecosystem Change*", of Assignment 2.

Students will achieve outcome 2.4 by completing Part II, "*Comparing Fat and Water Solubility*", and Part III, "*Take a Stand: The Use of Chemical Pesticides in City Parks*", of Assignment 2. Parts II and III come from BLMs 1.11a and 1.11b. The answers can be found in the Teacher's Resource.

Suggestions for Assessment

BLM 1.9, *"The Nitrogen Cycle"*, can be used to help students study the nitrogen cycle.

Resources

BLM 1.9, "*The Nitrogen Cycle*".

Article entitled "*Human Alteration of the Global Nitrogen Cycle: Causes and Consequences*": http://www.epa.gov/watertrain/nitroabstr.html

Assignment 2, Part I, "*Ecosystem Change*", Appendix A.

Assignment 2, Part II, "*Comparing Fat and Water Solubility*", and Part III, "*Take a Stand: The Use of Chemical Pesticides in City Parks*", Appendix A.

Outcomes

2.4.2 Define bioaccumulation.

2.4.3 Describe how pesticides such as DDT reach higher concentrations as they are transferred to the higher trophic levels of a food chain.

2.4.4 Describe the four categories of pesticides.

2.4.5 Examine the use of pesticides over the course of human history.

2.4.6 Outline the pros and cons of water soluble pesticides

Notes for Teaching and Learning

Students should realize that the decision of whether or not to use pesticides is not always clear. Jobs may be lost, non-target organisms may be killed, food chains may be destroyed, etc. It is important for students to realize that pesticide use is a complex issue.

While water soluble pesticides are much safer and do not remain in the environment for long periods, these chemicals still have unintended impacts on the environment. Instructors may wish to access members of the community (e.g. environmental groups, forestry workers, lawn care companies, Department of Forestry) who have knowledge of the issues. This ties in with the lab activity in Assignment 2, Part II. See page 56 of the Teacher's Resource for suggestions for this activity.

Students will be expected to complete either Option 1 or Option 2 of Assignment 2, Part IV. Option 1 consists of questions from Section 1.11 of the text. Option 2 consists of questions based on Section 1.10 of the text including *Take a Stand: Perspectives on Organic Farming.* Option 2 will require use of the internet.

Suggestions for Assessment

Instructors should ensure that all necessary terms are being added to the student's vocabulary list.

As with the Assignment 1, any new material covered in the assignment for this unit should not be tested. Instructors should assign a mark for the assignment for this unit and use that mark as part of the final evaluation for the course.

Instructors may wish to give a test at the end of this unit to cover the material covered so far.

Resources

Assignment 2, Part IV, Option 1 and Option 2, Appendix A.

Unit 3 - Population Ecology

Outcomes

3.1 Explain biotic and abiotic factors that keep natural populations in equilibrium.

3.1.1 Define population.

3.1.2 Differentiate between open and closed populations.

3.1.3 Identify and describe the four factors that affect population size:
(a) birth rate
(b) death rate
(c) immigration
(d) emigration

3.1.4 Use population histograms to compare and contrast young, stable and declining populations.

3.1.5 Graph and analyze population data to draw appropriate conclusions.

3.1.6 Define biotic potential, limiting factors, and carrying capacity.

3.1.7 Recognize the biotic and abiotic factors that can cause a population to increase or decrease.

Notes for Teaching and Learning

The term population has been used previously in the text. In this unit, students will understand the term from an ecological perspective. For the majority of students, the only population they will be familiar with is the human population. They should use the definition from the glossary of the text for population.

Students will need to be able to draw and interpret graphs in various forms in this unit, especially line graphs and histograms. Instructors may need to review these skills at the beginning of the unit.

While there are no questions in the Study Guide on the topic of human population growth, students should look carefully at Figure 2 on page 39. Instructors may give questions in the assignment for this unit related to interpreting the graph and how world population affects resources.

Suggestions for Assessment

Instructors should assess the student's level of understanding by reading student answers to questions from the Study Guide for this unit and providing feedback.

Instructors should ensure that all necessary terms are being added to the student's vocabulary list.

BLM 1.12b *"Comparing Biotic Potential"*, can be used as part of the assignment or to review the factors that regulate biotic potential.

Students are required to complete Assignment 3 to cover some of the outcomes for Unit 3. Part I, *"Making a Histogram"*, the Activity on page 39 of the text, is the same as pages 55 - 56 in the Student Record of Learning and has been included in Appendix A. Alternatively, students could be asked to collect their own population data for a specific location.

Assignment 3, Part II, BLM 1.12a, *"Case Study: Yeast Population"*, is a graphing exercise that is used to illustrate what happens to a closed population of a species with a high biotic potential when there is plenty of food available initially and what happens when the food supply runs out. A copy has been included in Appendix A.

BLM 1.13c, *" Understanding Exponential Population Growth"*, provides an activity that will help students understand exponential growth. It could also be used as part of the assignment.

Pages 57 - 58 in the Student Record of Learning could also be used as part of the assignment.

Resources

Science 10: Concepts and Connections, pages 38 - 41.

Science 10: Concepts and Connections, *Teacher's Resource*, pages 58 - 60.

BLM 1.12a, "*Case Study: Yeast Population*".

BLM 1.12b "*Comparing Biotic Potential*".

BLM 1.13c, "*Understanding Exponential Population Growth*".

"*Making a Histogram*", page 39.

Student Record of Learning, pages 55 - 58.

Outcomes

3.1.8 Describe the four factors which regulate the biotic potential of a species.

3.1.9 Explain the difference between density-dependent factors and density-independent factors.

3.1.10 Recognize the impact of the introduction of a new species population into an ecosystem.

Notes for Teaching and Learning

Answers to all questions included on the BLMs are provided in the Teacher's Resource.

Outcome 3.1.10 will be covered by completing Assignment 3, Part III, *"Introduction of a New Species"*. If students do not have internet access, instructors should visit the sites and provide printed material for the students.

Unit 3 - Population Ecology

Suggestions for Assessment

Assignment 3, Part IV, *"Setting a Moose Licence Quota"*, is optional. It consists of BLM 1.12d, " *Setting a Moose Licence Quota"*. It provides a case study which shows how humans use population data to help maintain a sustainable moose population while allowing hunting to occur. It could help students relate some of what they are learning to real life.

Instructors should ensure that all necessary terms are being added to the student's vocabulary list.

As with the other assignments given in this course, any new material covered in the assignment for this unit should not be tested. Instructors should assign a mark for the assignment for this unit and use that mark as part of the final evaluation for the course.

Instructors should assign a mark out of 10% for the written notes generated from answering the questions in the Study Guide. Students should also be assigned a mark for lab reports and/or other assignments.

A final comprehensive exam should be given. The mark for this exam should comprise at least 50% of the final mark for the course.

Resources

BLM 1.12d, *"Setting a Moose Licence Quota*".

Appendix A, Assignment 3, Part I, *"Making a Histogram"*, Part II, " *Case Study: Yeast Population"*, Part III, *"Introduction of a New Species"*, Part IV (Optional), *"Setting a Moose Licence Quota"*.

Appendix A

Assignment 1, Part I

Instructions: Read the article, "*The Diversity of Life*", and write answers for the **Analysis** questions at the end of the article.

The Diversity of Life

When studying ecosystems, ***biologists*** use the term ***biodiversity*** to describe the types of plants and animals found in an area. Biodiversity is the total of all living organisms in an area like a park, a lake or a whole province. In Newfoundland and Labrador, this might include bears, wolves, spruce trees, trout, frogs and eagles. It would not include elephants, tigers, crocodiles or palm trees since these organisms are not normally found here. All living things on our planet are connected. No one thing can live in isolation from other living things. Plants need the sun to make their food, then animals eat plants and other animals. Living things die and ***decomposers*** break them down so that new plants can make food. This has been the cycle of life for billions of years.

An ***ecosystem*** is the interaction of living organisms (plants and animals) and their physical environment like water, soil and sunlight. Without biodiversity, these systems of life would not work properly or survive. Having a wide diversity of life on Earth is important for three reasons:

1. ***Ecological Values***

All living things are supported by the way plants and animals use their environment. Loss of biodiversity makes an ecosystem ***unstable***, more vulnerable to extreme events, and weakens its natural cycles. For example, the ***carbon/oxygen cycle*** balances the amount of carbon dioxide and oxygen on Earth through living things like plants and animals. Carbon and oxygen move through living things by animal breathing and plant decay. Even the burning of fossil fuels generates carbon dioxide (CO_2) in the atmosphere. An example of this would be when gasoline is burned in cars or when garbage is burned in incinerators. Trees and plants use CO_2 to make food (in the form of sugar) that is necessary to grow. Then they release oxygen (O_2) back into the atmosphere, which gives air to breath.

2. ***Economic Values***

Many different living organisms in the environment provide humans with things needed to live. This forms the basis for our economy. Everything we buy and sell originates from the natural world. For example, the lumber that we build our homes with comes from trees in our forests. The food we eat comes from both the natural world and from man-made farms where fruits, vegetables, and animals are raised. About 40% of the drugs used for medicine are developed in some way from the variety of wild plants and animals in our world. This often includes the weeds we consider pests and things that are poisonous to us. Before the making of ***synthetic*** drugs, humans used natural medicines and in many places of the world this is still true. For example, dandelion root can be used to make a laxative while morphine is obtained from poppy flowers.

3. ***Cultural Values***

Most people feel connected to nature, often for reasons that can be hard to explain. Some people love the woods and others love the ocean. Both are heavily connected to the culture of Newfoundland and Labrador. In our province, the lifestyles of past generations depended on the natural environment.

The Ocean provided fish for food and for money, the land provided wood for shelter and heat, and wild animals provided extra meat during the long winters. Today, the people in our province still show a connection to the environment. In fact, the people from Newfoundland and Labrador are well known across North America for their special connection with nature. We use it for recreation, sport, hunting and fishing, hiking, camping and many more activities. Thus our cultural diversity is strongly linked to our province's biodiversity.

Biologist: A person who studies living things and where they live.	**Biodiversity**: The different types of living things in an area.
Decomposers: Things like mushrooms, worms and insects that break down dead organisms.	**Ecosystem**: A place where organisms live together sharing their physical environment.
Unstable: Not able to continue without help.	**Carbon cycle**: Natural cycle of carbon from living things to the atmosphere and back.
Oxygen cycle: Natural cycle of oxygen from the atmosphere to living things (breathing) and back.	**Synthetic**: Not occurring naturally; made by humans.

Analysis

1. a) What is biodiversity?

   b) Why is important to the cycle of life?

2. a) What is an ecosystem?

   b) How are ecosystems connected to biodiversity?

3. Explain three reasons why diversity of life is important to people.

4. Make a list of the many plants, animals and other living things that make up biodiversity in your area. When you are finished, use the following table to organize your list.

Plants - Write in the names of some local plants and indicate the group they belong to by placing an X in the appropriate block.

Plant Name	Conifer	Deciduous	Shrub	Grass	Moss	Other

Animals - Write in the names of some local animals and indicate the group they belong to by placing an X in the appropriate block.

Animal Name	Insect	Herbivore	Bird	Predator	Fish	Rodent	Other

Assignment 1, Part II

Instructions: Read the article, "*Loss of Biodiversity*", and write answers for the **Analysis** questions at the end of the article.

Loss of Biodiversity

How are we contributing to the loss of biodiversity around the world? As the number of human beings increases so does our dependence on technology. This causes an increased need for energy to power that technology. This puts greater pressures on both our ***local*** environment and even on the ***global*** environment. Because our North American society is strongly connected to economics and the importance of making money, our ever-increasing demand on our environment is adding to biodiversity loss. In fact, the rate of loss is now higher than it ever was before.

Extinction can be defined as the permanent disappearance of an organism. In other words, all the members of one type of organism have died. This means a loss of biodiversity. According to the David Suzuki Foundation, we are endangering the existence of living things to the point where we are losing at least one per cent of existing species per decade. This means we are losing at least two species an hour. That is 2,500 times greater than the rate due to other natural processes.

When organisms become extinct they are gone forever. Their contributions to other organisms are also gone forever. Food, shelter and medicines linked to many organisms are lost forever. Considering there may be potential cures for some cancers and other diseases, it seems unfortunate we would allow this to happen. The movie "*Medicine Man*" starring Sean Connery shows just how important these plants and animals are to the world.

In our province we have lost the great Auk, the sea mink, the Newfoundland wolf, and the Labrador duck. The full impact of their disappearance is not known. Others are ***threatened*** or ***endangered*** like the pine marten, the piping plover and the wolverine. If they go the way of the great auk, what will the effects be?

Local: The environment close to us.	**Global**: Refers to the whole planet.
Extinction: When all of one organism has completely disappeared.	**Threatened:** Decreasing in number, close to endangered.
Endangered: Continuing to decrease, close to extinction.	

Analysis

1. What is contributing to biodiversity loss around the world?

2. What does the term “extinction” mean?

3. What does the David Suzuki Foundation say is the current rate of extinction? How much greater is this compared to the past?

4. List three ways that biodiveristy loss can affect us in Newfoundland and Labrador?

5. a) List the names of three organisms that have become extinct in Newfoundland and Labrador.

   b) List three organisms that are threatened or endangered.

Assignment 2, Part I

Instructions: Read the article, "*Ecosystem Change*", and write answers for the **Analysis** questions at the end.

Ecosystem Change

Earth has been circling the sun for more than four billion years. During that time, the matter or materials on our planet keep changing form. For example, water ***evaporates*** from the ocean as a gas, goes into the clouds, ***condenses*** and falls as snow or rain. Igneous rocks are born in volcanoes and spit out as lava, then cooled until solid. Over time they are broken down into dirt. This is washed as ***sediment*** into rivers. In turn, it is compressed back into rock. Another example could be plants taking carbon dioxide (CO_2) gas from the atmosphere and converting it into sugars and oxygen. Animals use both for their life processes and produce carbon dioxide.

So why doesn't all the ocean water turn into mountain snow, or all the rocks turn into sediment or all the ***atmospheric*** carbon dioxide turn into sugar? Earth still has oceans, mountains and atmospheric carbon dioxide because they are part of the cycling of matter - the water cycle, the rock cycle and the carbon/oxygen cycle. Water falls from the sky, flows in rivers and back to the oceans where it evaporates once more, to again make clouds; buried sediments reach the surface through volcanoes or erosion (wearing down of rocks), and animals chemically change sugars into carbon dioxide that goes back into the atmosphere. These cycles are the key to change and stability in nature. When things like oxygen and water in our world are used up, they have to be replaced through the recycling of matter. In this way, ecosystems are able to change, yet remain stable. When systems change, yet remain ***balanced***, they are said to be in ***dynamic equilibrium***. Dynamic means a system is always changing, but equilibrium refers to something remaining constant. To maintain a healthy balance, change in an ecosystem is necessary.

Earth is a recycling planet, a planet in dynamic equilibrium. Everything on Earth has been here since the planet was formed about six billion years ago. We do not get new matter and old matter does not go away into space. The same matter keeps getting used over and over again. We can say that Earth is essentially a ***closed system*** with respect to matter.

Since new matter cannot replace old matter, recycling or cycling of materials is very important. There are three important principles necessary for this balance to work:

1. **Matter must cycle**

   Each of the elements that are vital for life exists on Earth in a closed ***loop of changes***. This means a constant changing of matter from one thing to another, but, the total amount of matter does not change. This may mean chemically changing some things, for example iron and water creating rust; or physically changing others, like water to ice or steam.

2. **Energy must flow**

   The functioning of our planet depends on a constant input of energy from the sun. This energy leaves Earth in the form of heat flowing to outer space. Earth is an ***open system*** with respect to energy. Energy from the sun enters the environment through the making of food by plants, a process call ***photosynthesis***. From here, animals eat the plants and some of the energy moves from the plants to the animal. As animals eat other animals, energy moves through the ecosystem. Eventually is it lost entirely to the environment.

3. **Life is connected**

   A vast and complicated network of relationships connects all of Earth's organisms with each other and with the cycles of matter and the flow of energy. Earth is a ***network of systems*** with respect to life. The connection between living organisms and their physical environment is the basis of all ecosystems on Earth.

Knowledge of these three principles can help us understand all environmental issues. When we deal with an environmental issue, we should first explore the roles of matter, energy and living organisms. Where does the matter (carbon, water, pollutant) come from and where does it go? Does the problem involve changes to our planet's energy flow? How do plants, animals and microorganisms influence it and how are they affected by it? As a result of answering these kinds of questions, we will discover that these three guiding principles provide an organizing framework that makes common sense out of complicated issues.

Evaporates: When a liquid slowly changes to a gas.	**Condenses**: When a gas changes to a liquid, like steam to water.
Sediment: A small piece of rock or dirt that sedimentary rocks are made of.	**Atmospheric**: Relates to things in the air.
Balanced: This means that things are equal or stable.	**Dynamic Equilibrium**: This means things are changing but staying in balance.
Closed System: This is a system that does not receive any new matter or materials.	**Open System**: A system that can receive new matter or material.
Photosynthesis: This is the process plants use to make food from CO_2 (carbon dioxide) and sunlight.	**Network of Systems**: All the living and nonliving systems interacting to create balance.

Analysis

1. Describe what happens to matter on Earth.
2. Why is change necessary in any ecosystem?
3. What does dynamic equilibrium mean in terms of ecosystems?
4. What is a closed system? Give an example.
5. What is an open system? Give an example.
6. Explain how Earth acts as a network of systems.
7. Explain the three principles needed for a balanced ecosystem.

Assignment 2, Part II

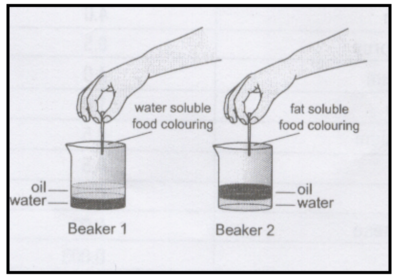
Comparing Fat and Water Solubility

What are some dangers of chemical pesticides? Why does DDT have such a toxic effect on ecosystems?

Whereas modern chemical pesticides are water-soluble, DDT is fat-soluble. It is stored in animal tissues and cannot be eliminated from the body.

Procedure:

1. Put 1 cm of water into two small beakers, labeled 1 and 2.



2. Add an equal quantity of vegetable oil to each beaker.
3. Dip a flat toothpick into some water-soluble food coloring.
4. Swish the toothpick around inside Beaker 1.
5. Dip a flat toothpick into some fat-soluble food coloring.
6. Swish the toothpick around inside Beaker 2.
7. Swirl each beaker to mix well.
8. Compare the final color of the oil layer.

1. What was the final color of the oil layer in Beaker 1? Explain why.

____

____

2. What is the final color of the oil layer in Beaker 2? Explain why.

____

____

3. Considering solubility, why do so many pesticides stay in the food chain?

____

____

Assignment 2, Part III

Instructions: Read the information below and complete the sections as indicated.

Take a Stand: The Use of Chemical Pesticides in City Parks

Note: You should do this with a partner if possible.

On your way home from school, you notice that the municipal workers are spraying insecticide on the grass and bushes in the neighborhood park. The bugs are bad this year, and it would be nice to sit on the swings without being eaten alive, but this is where you take your little brother to play. He crawls all over the grass and likes to put things in his mouth. You wonder how dangerous the chemicals are, how long it takes them to break down in the environment, and why there is no sign warning of the spraying.

Your neighbors are also worried. You learn there will be a public meeting on this topic, and feel you can contribute, with your new knowledge of pesticides.

There are two opposing positions on this issue. To prepare for the meeting, list all the possible supporting points that each side could present. Use point form and vocabulary from the unit.

PRO: Chemical pesticides should be used in city parks	CON: Chemical pesticides should be banned from city parks

In real life, many compromises are made. Describe a compromise position in this issue. Under what conditions could pesticides be used safely?

COMPROMISE: Pesticides may be used under certain conditions

Assignment 2, Part IV, Option 1

Instructions: This part of the assignment is based on the case study, "*Pesticides*", on pages 34 - 37 of your text. You should read these pages carefully, then complete the following:

1. List three possible short-term benefits of pesticides.

   (i) ______________________________

   (ii) ______________________________

   (iii) ______________________________

2. Study **Table 1** on page 34 of your textbook.

   (i) Which pesticides decompose rapidly?

   ____

   ____

   (ii) Which pesticides stay in the ecosystem for years?

   ____

   ____

3. Vultures and some types of beetles feed on the dead bodies of animals from several trophic levels. What is the effect of bioaccumulation on these animals?

   ____

   ____

4. Why should Canadians be concerned that other countries have not banned DDT?

   ____

   ____

5. Breast milk contains fat. How could breast-feeding affect the concentration of DDT in a mother and in her baby?

6. Why are the new pesticides less harmful to ecosystems than DDT?

7. What industry used the most pesticides, according to **Figure 5** on page 36 of your text?

8. Why do you suppose the spruce budworm has not been eliminated after 40 years of pesticide spraying?

9. What might happen if biologists used really large amounts of pesticides to kill all the spruce budworm?

10. What groups of people might have benefitted from New Brunswick's spraying program?

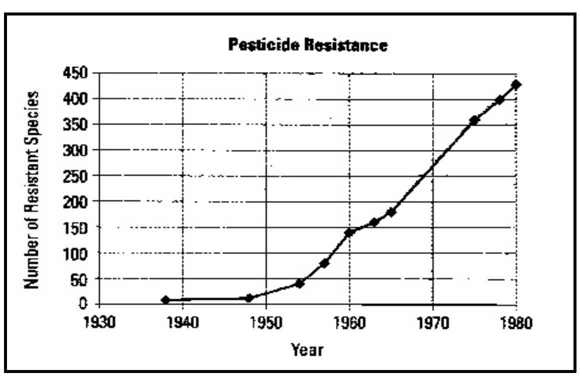
11. Identify groups of people who may have suffered as a result of the decision not to spray?

12. What are the benefits of not spraying?

13. Why would female eagles have slightly lower levels of toxins in their bodies than male eagles?

14. Draw a food web, showing the movement of pesticides in a lake from aquatic insects to the bald eagle.

15. Study the information presented in the graph. In which decade was there the greatest increase in the number of species that became resistant to pesticides? ____________________



16. What might account for this dramatic increase?

17. Draw a forest food web with at least 12 organisms.

(i) Identify an organism in your web that could be considered a pest.

(ii) In what ways would this web be affected if the pest was removed?

18. What do we know today about using arsenic, lead or mercury as pesticides?

19. Why do so many pesticides stay in the food chain?

20. The ideal pesticide has four characteristics, as bolded below. Explain why each characteristic is important, and what would happen if the pesticide fails the test.

(i) The pesticide should **kill only the intended pest** because

(ii) The pesticide should **disappear into something harmless after it works on the pest** because

(iii) The pesticide should **not create a stock of resistant pests** because

(iv) The pesticide should be **cheap to produce and use** because

Assignment 2, Part IV, Option 2

Instructions: First you should review Section 1.10 of the text and complete the questions below. Then you should read carefully "*Perspectives on Organic Farming*" on page 33 and answer the questions included there.

1. Why does the nitrogen level in fields decline when crops are harvested?

2. How do excess fertilizers affect decomposers in soil?

3. How do excess fertilizers affect decomposers in water?

4. List the benefits and risks of fertilizer use.

Benefits of fertilizer use	Risks of fertilizer use

5. Human waste contains nitrates and nitrites. Before sewer systems were developed, the backyard outhouse collected human waste. Outhouses can still be found at some cottages. Outhouses consist of a small building over a hole in the ground. Using information you have gained about the nitrogen cycle, explain why outhouses pose a risk to nearby lakes.

Work the Web

Briefly summarize your research into the role of earthworms in helping decomposition and soil quality.

What recommendations would you make to farmers based on your research?

Assignment 3, Part I

Instructions: Complete the activity "*Making a Histogram*" as outlined below.

Making a Histogram

To draw a histogram, you must start with population data in the table below.

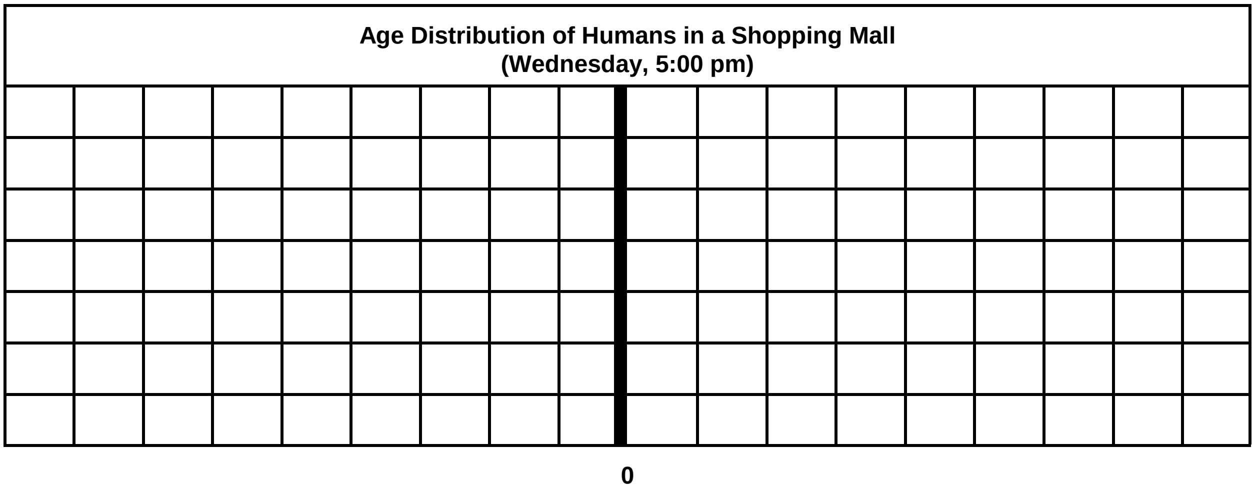
Age Distribution of Humans in a Shopping Mall (Wednesday, 5:00 pm)		
Ages	**Female**	**Male**
0 - 4	8	7
5 - 9	6	4
10 - 14	8	2
15 - 19	5	1
20 - 24	3	5
25 - 29	9	3

- Write the population size values along the *x*-axis, extending to both the right and left of the *y*-axis. Decide which half will represent the female population and which half will represent the male population.

- For the first age category (0 - 4 years old), draw a bar for the number of females (8) on one side and a bar representing the number of males (7) on the other. Make sure to label the age distribution.

- Add a bar for each of the age categories.

1. Complete the histogram showing age distribution from a shopping mall.



2. What conclusions can you draw from reading the histogram?

____

____

3. How might these results differ if readings were taken at 10:00 am on a Monday?

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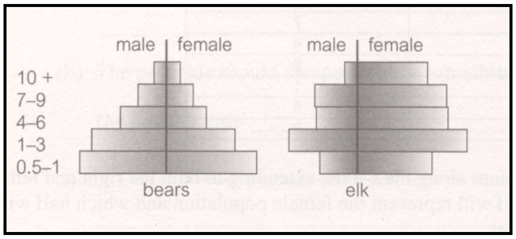
4. How might these results differ if readings were taken at 10:00 am on a Saturday?

____

____

Compare the populations in the histograms below.



1. Which population appears to be most stable?

____

2. Identify differences in growth patterns of elk and bears.

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Assignment 3, Part II

Instructions: Complete the case study "*Yeast Population*" as outlined below.

Yeast Population

Yeast are single-celled fungi that use sugar as a food supply. When deprived of oxygen, they convert sugar to carbon dioxide gas and alcohol. This reaction releases energy, and the yeast use that energy to grow and reproduce rapidly.

An experiment was conducted over a period of nine days. The purpose of the experiment was to examine the growth pattern of a population of yeast. The experimenters placed a sample of yeast in a sterilized molasses and water mixture and counted the population each day.

The following table shows the data obtained.

Time (days)	1	2	3	4	5	6	7	8	9
Number of Yeast Cells (per ml)	2	3	8	19	33	68	44	12	0

1. Use the data to plot a line graph of time (on the horizontal axis) against the number of yeast cells (on the vertical axis).

2. Describe the shape of the graph.

3. Explain and give reasons for the population pattern from days one through six.

4. Explain what might have caused the change in the growth pattern from day seven through day nine.

Assignment 3, Part III

Instructions: Read the information below and visit the websites as indicated. Choose one of the introduced species and briefly explain how its introduction has affected the natural populations.

Note: *If you do not have internet access, your instructor will provide the necessary information for this part of the assignment.*

Introduction of a New Species

Introduction of new species into areas is perhaps the greatest single factor to affect natural populations. More than 1500 insect species and more than 25 types of fish have been introduced into North America as well as more than 3000 species of new plants. The majority of accidental introductions may fail. However, once an introduced species becomes established, its population growth is explosive. An example of a species introduced to the island of Newfoundland is the moose which has grown to a large population.

There are several other examples of species introduced in Newfoundland and Labrador. These include **frogs** and **shrews** as well as the **hemlock looper** and **spruce budworm**. Visit the websites listed below to investigate the environmental, social, and economic impacts these non-native species have had on the province's ecosystem.

http://www.gov.nl.ca/snp/Animals/moose.htm

http://www.gov.nl.ca/snp/Animals/snowshoe_hare.htm

http://www.gov.nl.ca/env/Env/PollPrev/pesticides/protecting_the_forests.asp

http://www.enature.com/fieldguide/showSpeciesGS.asp?curGroupID=5&curPageNum=7&recnum=MA0164

Assignment 3, Part IV (Optional)

Setting a Moose Licence Quota

Wildlife management use information on population changes to manage the population of moose and other big game so that the resource can be harvested while maintaining the population at a sustainable level.

The management of wildlife populations is done over a long term and relies on accurate data collection. It is very important, for example, to have a good reliable estimate of the current population. The main method used to determine a population estimate is the aerial survey. Using this method, a population ecologist flies over a sample section of a larger area and counts the number of animals. With the number of animals counted in the sample section, the ecologist is then able to calculate the total number of animals in the whole area.

Wildlife management uses data on the natality, mortality, and average hunter success and then determines the quota according to whether they want the population to increase, decrease, or remain stable.

Example:

Moose Population Data	
Population Estimate (current)(P)	4050
Natality (N)	35%
Mortality (including poaching) M	12%
Average Hunter Success (HS)	75%
License Quota = P × [N - (M +DC)] × HS	

1. If the population of moose in the area is becoming too large and a 10% decrease in the population is desired [desired change (DC) is 10%], use the data in the table and the formula provided to calculate the licence quota.

____

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2. What should the quota be if wildlife management want a 10% increase in the population?

3. How many licenses should be issued if wildlife management want the population to remain stable?

4. Are there other factors that might have an effect on the moose population of an area? Can these factors be included in the formula for calculating the license quota?

Appendix B

The Oxygen and Carbon Cycles