



Connecting with the Natural World
Junior Division Integrated Curriculum

Grade 6 Biodiversity Activities



in partnership with



*This resource has been developed by the
Science Teachers' Association of Ontario/L'Association des professeur de science de l'Ontario
with funding and technical support from
Ontario Teacher's Federation/Fédération des enseignantes et des enseignants de l'Ontario*

STAO Writing Team

Sheila Rhodes, Project Manager, Instructor, Faculty of Education,
University of Ontario Institute of Technology

Kimberly Arfo, Curriculum and Instruction, Peel District School Board

Sarah Feddema, Durham District School Board

Jocelyn Paas, Science and Biology Teacher, Peoples Christian Academy

Judy Wearing, Senior Editor, The Critical Thinking Consortium

Reviewers

Bonnie Anderson, Peel Field Centres, Peel District School Board

Corrine Brook-Allred, Pickering (Retired)

Victoria Winchester, Russell Public School

Care has been taken to trace the ownership of copyright material contained in this document. STAO will be pleased to receive information that will enable it to rectify any errors or omissions in subsequent editions. Send comments to info@stao.ca

Teachers are permitted to make copies of this document for their classroom use.

©STAO/OTF 2012 The material in this document shall not be copied nor reproduced beyond a classroom without the permission of Science Teachers' Association of Ontario/L'Association des professeurs de science de l'Ontario [STAO/APSO]

Table of Contents

Overview for Grade 6 Biodiversity Activities	4
Lesson #1: Anticipation Guide for Outdoor Observation	5
Lesson #2: Web of Life Interrelationships	5
Lesson #3: Create Your Own Creature: A Lesson Celebrating Diversity	5
Lesson #4: Virtual Collections: A Classification Activity	5
Lesson #5: Miniature Investigative Nature Trail	5
Lesson #6: Invasive Species Investigation	6
Lesson #7: Biodiversity Garden: A Culminating Task	6
Scenario Approach	6
Environmental Crusaders	7
Additional Activities	8
Mini - quadrat investigation	8
Taxonomy exploration	8
What if?	8
Benefits of Biodiversity	9
Lesson 1 - Anticipation Guide for Outdoor Observation	10
Minds On	11
Connections	12
Action.....	12
Connections.....	12
Consolidation	12
Anticipation Guide	14
Answer Guide	16
Lesson 2 - Web of Life Interrelationships	19
Minds On	21
Connections	21
Action	21
Connections	22
Consolidation	22
Extension	23
Sample ICE Rubric:	25
Lesson 3 - Create Your Own Creature: A Lesson Celebrating Diversity	26
Minds On	28
Connections	28.
Action.....	29
Connections	29
Consolidation	30
Sample observation card	31
Resources:	32
Lesson 4 - Virtual Collections: A Classification Activity	33
Minds On	34
Connections	35
Action	35
Connections	35
Consolidation	36
Resources	37

Lesson 5 - Miniature Investigative Nature Trail	38
Minds On	40
Connections	41
Action	41
Connections	42
Consolidation	42
Sample template for Nature Detective Sheet:.....	43
Extensions	44
Sample Rubric.....	45
Resources	46
Lesson 6 – Invasive Species Investigation	47
Minds On	48
Connections	49
Action	49
Connections	50
Consolidation	51
Resources	52
Lesson 7 - Biodiversity Garden: A Culminating Task	54
Minds On	57
Connections	58
Action	60
Connections	61
Consolidation	61
Checkbric.....	62

Overview for Grade 6 Biodiversity Activities

The lessons in this set of activities are written from the perspective that Biodiversity can be learned best in the outdoors where the diversity of life can be discovered and experienced by students first hand, and not simply read about in a book or viewed on a computer. Each lesson is inquiry and experiential based, where students' natural sense of wonder and discovery is encouraged.

Integration with other disciplines has been provided throughout the lessons. Special consideration has been given to the social studies curriculum since the expectations to explain the importance of international cooperation regarding global issues and the effectiveness of Canadian actions coincide with the stewardship aspect of the Biodiversity unit. For examples of this integration, see the Grade 6 Biodiversity Unit Web of Life Interrelationships, Miniature Investigative Nature Trail, and Invasive Species Investigation lessons. Other disciplines that are cross-curricular within this science unit are physical education in the Invasive Species Investigation and visual arts in Virtual Collections; A Classification Activity, The Miniature Nature Trail, Web of Life Interrelationships, and Create Your Own Creature. Technology in the outdoors is integrated in Virtual Collections; A Classification Activity.

The lessons vary in time required and complexity. You will find a continuum from a thirty minute Web of Life game that develops the concept of interrelationships that you can just step outside your classroom door and enjoy, to a four part Invasive Species Investigation that gives opportunity for community stewardship action. All the lessons are written with details for you, the teacher, to provide fun, challenging, interactive activities for your students in the outdoors.

Safety in the outdoors should be reviewed in each lesson. A detailed explanation is given in the Overview Section of the entire document, but a brief summary of safety instructions you will need follows:

1. Take a walk around the area where you would like to bring your class or group to look for safety issues, both natural and human-made, such as barbed wire fences, poison ivy or other poisonous plants (such as stinging nettles), broken glass, etc.
2. Prepare your students so that they dress appropriately for the terrain and weather, e.g., proper hiking shoes, sunscreen, hats, etc.
3. Have students bring water if you are planning to be outside longer than 30 minutes.
4. Have students organized in partners and have them work together or in small groups, never alone.
5. Organize your class activity so that all students are visible to you or else the students are in a clearly marked area within hearing distance of your whistle or bell.

Lesson #1: Anticipation Guide for Outdoor Observation

This activity involves students making predictions regarding what they will observe about the diversity in an outdoor area, either in a schoolyard or community area, and may be used as assessment for learning in the beginning of the unit, then an assessment as learning throughout the unit, as well as an assessment of learning at the end of the unit. A sample assessment tool can be found at the end of the activity.

Lesson #2: Web of Life Interrelationships

This is an activity to develop the concept of interrelationships that can be done just outside the classroom door. It takes approximately 30 - 45 minutes and does not require a natural area. On a rainy day, a gymnasium will work, but it is more fun outdoors. The concept of interrelationships within the web of life is visualized with a ball of string connecting students representing organisms at different trophic levels. The extension is cross-curricular with the Social Studies big idea of interrelationships; the actions of Canada and Canadians can make a difference in the world. It is also cross-curricular with art and language. Other concepts developed are food chains, food webs, and interdependence.

Lesson #3: Create Your Own Creature: A Lesson Celebrating Diversity

This activity will develop the concept of organism diversity within classification systems and the understanding of the variety of life on earth among the physical landscapes that support them. The lesson is cross-curricular with Art as students use their imaginations and art materials to create a unique creature with characteristics that can be classified. The activity is divided into three 60 minute sessions.

Lesson #4: Virtual Collections: A Classification Activity

Technology and biodiversity expectations are incorporated in this outdoor activity that enables students to classify organisms. Students will take pictures of a variety of living organisms, classify them, and display them in an area of the school where others can learn from and enjoy them.

Lesson #5: Miniature Investigative Nature Trail

This activity will bring the students outside and give them an opportunity to investigate an outdoor environment, design and implement a miniature nature trail, and communicate their findings of organisms to others. This activity should be used to develop the concept of classification and allow students to use their knowledge of classification gained in previous lessons to classify the organisms found. (See the virtual collections lesson for an example of a lesson teaching classification.) This activity will allow all students, including students with special needs, to have an opportunity to explore the natural world as mandated in the Ontario Ministry curriculum guidelines for the Grade 6 Biodiversity unit.

Lesson #6: Invasive Species Investigation

This lesson is a four-part lesson sequence. It introduces the concept of alien and invasive species, and allows students to identify invasive species in their schoolyard and community through an activity that is cross-curricular with physical education. Students research what is being done to control invasive species and have an opportunity to help control invasive species in their schoolyard and community. Students investigate the link to the social studies curriculum by addressing the importance of international cooperation in the issue of invasive species that affects Canadian ecosystems. The time required for the first three parts is three hours. The extension is variable depending on the location of invasive species.

Lesson #7: Biodiversity Garden: A Culminating Task

In this culminating task, students will investigate the issue of monoculture systems of agriculture and sustainable agriculture. They will also develop the concept that biodiversity is crucial for healthy ecosystems. The students will compare the cost and benefits of a monoculture system farm and an organic farm with diversity. Next, they will research, design, and implement plans to build an organic vegetable garden. This task is cross-curricular with the social studies big idea that “Many different communities have made significant contributions to Canada’s development”. The end result of this task will allow students to create a vegetable garden that they can tend and harvest. Opportunities to be good stewards of our resources and sharing the harvest with the community will complete the experience.

Scenario Approach

Using scenarios or having the students be part of a story is an effective way to develop biodiversity concepts. For an example of a fully developed scenario, see the Grade 4 Habitats and Communities activities. Here are a few suggestions to get you started.

New National Park to be Created

Create a “News Flash” from the local newspaper with the headlines, “New National Park to be Created”, and date it the day you start the set of activities. The secondary headline should read, “Government looking for new location for the park – community input required”.

Print off several copies of the “newspaper” and hand it out at the start of the activities.

This could come as a text message or email as well. If using email for these activities, create a separate email account, such as Gmail, and use the name of a “newspaper reporter”. This allows you to send and receive important messages throughout the set of activities.

Include pictures of native plants and local points of interest that showcase what your community has to offer this new park. In the newspaper article, create a series of questions that must be addressed if your area is to be considered for this park. The park must be located in a spot that will not damage any endangered species. Communities need to consider impact on the local area.

- Divide the class into groups of citizens who have interest in having the new park in their area and some who are opposed
- Create sample “personalities” and hand out role cards to students. These can include city planner, local councillor, real estate agent, president of the local environmental group, school teacher, etc. These roles should represent a cross-section of the local community.
- Develop 4-5 possible locations for the park based on a variety of factors that would influence the attitude of the residents in the community
 - One location is near a spot where an endangered species hibernates or lays its eggs
 - One location is near prime agricultural land
 - One location is beside a new residential subdivision
- Groups do research using their roles and ideal locations
- This research can be carried out while doing the suggested set of activities that follow
- Groups present their findings to a “Town Hall” meeting based on their “roles” and selected location for the park
- Diagrams and maps of the local community will need to be presented
- Invite a local councillor or mayor to officiate at the meeting
- All groups must consider biodiversity of area and impact on putting park in this location

Environmental Crusaders

As young global citizens, you and your classmates are very interested in protecting the environment. You are concerned that not enough is being done in your community to protect the biodiversity of the area. You see more land being used for industrial buildings and more green space being lost. Your class decides it is time to take action! You decide to start a new club at your school that is environmentally focused.

Before you can start the club, you need to persuade the Principal that this club is essential in the school. You also realize that you might need some extra school funds for this project so you decide to approach the School Council for support. You realize that the time is right to get started on this important project.

Develop a plan of action for this club. Assign roles to the various members of the group to make sure that all areas have been covered. Be ready with a presentation to the School Council to explain your goals and local initiatives in the school community. You might want to use digital images to highlight your concerns. A blog might be another way to showcase your ideas.

Additional Activities

Mini - quadrat investigation

In this activity, groups of 4-5 students will use popsicle sticks or wooden skewers to mark out a 1 metre by 1 metre quadrat. Each group will be given a different ecosystem, if possible. For example, groups could use a concrete playground, grassy lawn, sandy area, wooded area, etc. The groups will look closely for diversity of life and the interaction between the physical landscape and the living organisms. The students will record the organisms and the interaction between the biotic and abiotic components of the quadrat. Consolidation will include sharing similarities and differences between the discoveries of all the groups. Key concepts addressed are diversity, interrelationships, and consequences of human impact on the environment.

Taxonomy exploration

The teacher will lead the students on a 30 minute hike recording, either with digital camera, iPads or pencil and paper, every living thing they can see or hear. When they return to the classroom, or when they stop at a resting spot outdoors, they will work with partners to divide everything they have found, first into broad taxonomic categories such as plant kingdom, animal kingdom, fungi kingdom or bacteria kingdom. Next, they will divide those categories into smaller categories using characteristics they can observe. For example, under plant kingdom, they could have three lists: plants with flowers or fruit, plants with cones, and plants with spores. Students will continue dividing their lists into more specific categories using characteristics they can observe until they cannot think of any more divisions. Key concepts addressed are classification, characteristics, diversity of life, observation skills.

What if?

Students take a sketch pad or piece of clean paper and art materials, such as pencils, pencil crayons, pastels, etc., and sit down at different places on the school property or local area. Students should have different views as they sit facing different directions. Each student should find a human-made structure to look at and draw. It could be a house, car, garbage container, parking lot, playground structure, store, sign, etc. The students should draw the outline of the structure, then draw a line through the middle. On one half, draw the human-made structure as they see it; on the other half, imagine what the area where the structure is would look like if humans had never been in that area. Would there be flowers growing there? Would there be a forest? Would animals be there? Insects? Worms? A lake? Encourage students to think of the diversity that might have been there. Students should use their imagination and their art materials to draw what they imagine the area might have looked like. Afterwards, the pictures could be displayed under a title: What If.....? Key concepts: Consequences of human use of land, biodiversity, conservation of resources, stewardship, interrelationships between species and the physical landscape. Artist resource for inspiration: Graham Curry exhibit, "What If We Were Landscapes", www.grahamcurry.ca

Benefits of Biodiversity

This activity will help students think about all the benefits humans receive from the diverse plants and animals in an ecosystem. The class will be divided into groups of three or four. Each group will go outside for 20 minutes and explore the schoolyard or local park, and make a list of all the plants and animals they can find in the area. The groups must be very specific with their list, e.g., “a red clover with blossoms”, instead of “a flower”. The class will gather together and the groups will think of as many ways those plants and animals are useful to humans or other animals in the ecosystem. Some examples would be: food, clothing, pollen for bees, beauty to enjoy, grass to sit on, insects to pollinate flowers for fruit, etc. They should write down all the uses they can think of. Next, the groups must cross off half of the plants and animals they found on their list to simulate a reduction of biodiversity. Now make a second list of uses for the plants and animals they found. The list will be significantly smaller. When discussing their lists, the teacher can ask questions about why reducing the different types of plants and animals resulted in less ecosystem services.

Grade 6 Biodiversity

Lesson 1 - Anticipation Guide for Outdoor Observation

Lesson Overview

This activity involves students making predictions regarding what they will observe about the diversity in an outdoor area, either in a schoolyard or community area, and may be used as assessment for learning in the beginning of the unit, then an assessment as learning throughout the unit, as well as an assessment of learning at the end of the unit. A sample assessment tool can be found at the end of the activity.

The time required is approximately 60 minutes.

Connections to Environmental Education

- *The earth's physical and biological systems*
- *The scientific and human dimensions of environmental issues*
- *Because all things are connected, maintaining diversity is critical*

Curriculum Expectations

Science - Grade 6 Understanding Life Systems: Biodiversity

- OE2 investigate the characteristics of living things, and classify diverse organisms according to specific characteristics
- SE2.1 follow established safety procedures for outdoor activities and field work
- SE2.3 use scientific inquiry/research skills to compare the characteristics of organisms within the plant or animal kingdoms system
- SE2.4 use appropriate science and technology vocabulary, including classification, biodiversity, natural community, interrelationships, vertebrate, invertebrate, stability, characteristics, and organism, in oral and written communication
- OE3 demonstrate an understanding of biodiversity, its contributions to the stability of natural systems, and its benefits to humans
- SE3.1 identify and describe the distinguishing characteristics of different groups of plants and animals
- SE3.2 demonstrate an understanding of biodiversity as the variety of life on earth, including variety within each species of plant and animal, among species of plants and animals in communities, and among communities and the physical landscapes that support them
- SE3.5 describe interrelationships within species, between species, and between species and their environment

Social Studies – Grade 6 Heritage and Identity : Communities in Canada, Past and Present

- OE A1 **Application:** assess contributions to Canadian identity made by various groups and by various features of Canadian communities and regions (FOCUS ON: *Cause and Consequence; Patterns and Trends*)

Social Studies – Grade 6 People and Environments: Canada’s Interactions with the Global Community

- OE B1 **Application:** explain the importance of international cooperation in addressing global issues, and evaluate the effectiveness of selected actions by Canada and Canadian citizens in the international arena (FOCUS ON: *Interrelationships; Perspective*)
- OE B2 **Inquiry:** use the social studies inquiry process to investigate some global issues of political, social, economic, and/or environmental importance, their impact on the global community, and responses to the issues (FOCUS ON: *Cause and Consequence*)

Learning Goals

- At the end of this lesson, students will have made predictions about what they discovered in their schoolyard.
- At the end of this lesson, students will have investigated plant and animal organisms in their schoolyard.
- At the end of this lesson, students will have compared characteristics of organisms they found.
- At the end of this lesson, students will be able to use scientific vocabulary to describe the distinguishing characteristics.
- At the end of this lesson, students will be able to identify an example of an invasive species in their schoolyard.

Instructional Components and Context

Readiness

- Prior knowledge of the difference between the animal and plant kingdoms, competition between organisms

Materials

- Anticipation Guide for each student, pencils, magnifying lens, nature identification field guides, such as Peterson or Audubon series
- iPads with nature applications installed, such as the Audubon app (optional)

Terminology

- vertebrates, invertebrates, insects
- competition
- invasive species
- plant and animal kingdoms

Minds On

Preparation: Safety for outdoor work must be discussed with the class. (See Safety in Overview section.)

Think-Pair- Share:

The students will be given the following anticipation guide to work with a partner and decide if they agree or disagree with the statements in the middle column.

The students will share their ideas with the class in small groups of 6 (they will find 2 other partner groups).

Connections

Assessment for learning

Assess before going outside opinions for completion and quality of thought put into choices. The teacher can use the students' choices to assess prior knowledge of biodiversity concepts.

Differentiated Instruction

Pair students at different levels of understanding so they can benefit from each other. If students are not ready to go outside, use flash cards or a word wall for vocabulary before the outdoor observation begins.

Action

Outdoor observation:

The students will go outside into the schoolyard with the class, working with their partner to find the answers to the questions. (Depending on the time allotted for this step, more than one class may be required.)

The students will gather at a designated spot or return inside to the classroom to check the third column in collaboration with their partner.

Connections

Assessment for learning

Assess achievement category Thinking and Investigation (T/I) as they are outside for inquiry (questions asked), and the depth of investigation. Anecdotal observations of the students' observations and questions they ask will help the teacher assess learning during the outdoor activity.

Differentiated Instruction

Students that have trouble identifying or finding evidence of statements may need extra help or support from teacher-lead inquiry. Observation of student questions will be a helpful assessment of help needed.

Consolidation

The students will assemble with their small group of 6 and share their results.

Assessment as or of learning

Assessment of learning would not be necessary if the activity is used to assess prior knowledge and stimulate interest in the unit. However, if it is also used as a post-concept evaluation to see what the students have learned, then assessment of learning would be appropriate. An example of a rubric is given that places student learning on a continuum by describing quantity and depth of a student's understanding. (Natural Curiosity 2011)

Differentiated Instruction

When students share results, some students may be unsure and not want to share. Reinforcement with nature guides, pictures, etc., should be available to assist students in their decision making.

Anticipation Guide

Before Going Outside		Statement	After Going Outside	
Do you agree or disagree with the statement? Explain.			Does your outdoor investigation support your opinion? Explain. Record your evidence in a written submission.	
Agree	Disagree		Supported	Unsupported
		1. There are invasive species living in my schoolyard.		
		2. Invertebrates outnumber vertebrates in my school yard.		
		3. A dead tree is a home to organisms in more than one kingdom.		
		4. Food chains are hard to find.		
		5. Ants can carry objects 10 times larger than their body length.		
		6. Moss can feel cool, even on a very hot day.		
		7. An insect cannot live inside the stem of a plant.		
		8. Trees can grow sideways to get sunlight.		

		9. Weeds are a nuisance and should all be destroyed.		
		10. A spider is an insect.		
		11. Plants compete for resources.		

Examples of answers for agree/disagree and support reasoning. Please note these are only examples! The goal of this activity is for the students to explore and discover many observations of the world around them in their schoolyard. There are NO exclusive answers!

Before Going Outside		Statement	After Going Outside	
Do you agree or disagree with the statement? Explain.			Does your outdoor investigation support your opinion? Explain. Record your evidence in a written submission.	
Agree	Disagree		Supported	Unsupported
X		1. There are invasive species living in my schoolyard.	Observe plants, such as purple loosestrife, animals, such as Japanese ladybug. Ask questions about how to limit invasive species.	
X		2. Invertebrates outnumber vertebrates in my school yard.	Should find many species of insects, crustaceans, spiders	
X		3. A dead tree is a home to organisms in more than one kingdom.	Should find moss, fungi, algae, arthropods, sow bugs, etc.	
	X	4. Food chains are hard to find.		Many food chains can be found – students will give examples.
X		5. Ants can carry objects 10 times larger than their body length.	Observations of ant in their environment carrying objects	
X		6. Moss can feel	Examine moss and its	

		cool even on a very hot day.	characteristics within its physical environment.	
	X	7. An insect cannot live inside the stem of a plant.		Galls could be found and opened on tree leaves or goldenrod plants; interrelationships noted.
X		8. Trees can grow sideways to get sunlight.	Observation of phototropism (plants growing toward sunlight)	
	X	9. Weeds are a nuisance and should all be destroyed.		Discussion about the use of plants found for food for birds, insects, and mammals, and the importance of having diversity of plants in a ecosystem
	X	10. A spider is an insect.		If a spider could be found, it could prove that it has 8 legs, not 6, and one body part, not 3.
X		11. Plants compete for resources.	Observation of plants growing close to each other and describe which one is dominant	

Example of Rubric : ICE Framework (modified from Fostaty-Young & Wilson, 2004, taken from Natural Curiosity, 2011, pg 33)

Ideas revealed when learners describe:	Connections are drawn when learners:	Extensions are revealed when learners:
Description of plants/animals	Explain the interrelationships between organisms	Apply their knowledge in new ways to biodiversity concepts
Basic terms used from previous knowledge	Explain a relationship between previous knowledge and biodiversity concepts	Ask and/or answer questions such as, “what can I do to help keep biodiversity in this schoolyard?” or “how can we keep invasive species out of our schoolyard and our community?”
Identification of organism in its habitat	Use language that shows understanding of invasive species	

Anticipation Guide template modified from:

http://www.readingrockets.org/content/pdfs/anticipationguide_3.pdf

Grade 6 Biodiversity

Lesson 2 - Web of Life Interrelationships

Lesson Overview

This is an activity to develop the concept of interrelationships that can be done just outside the classroom door. It takes approximately 30 - 45 minutes and does not require a natural area. On a rainy day, a gymnasium will work, but it is more fun outdoors. The concept of interrelationships within the web of life is visualized with a ball of string connecting students representing organisms at different trophic levels. The extension is cross-curricular with the social studies big idea of interrelationships; the actions of Canada and Canadians can make a difference in the world. It is also cross-curricular with art and language. Other concepts developed are food chains, food webs, and interdependence.

Connections to Environmental Education

- *The earth's physical and biological systems*
- *The scientific and human dimensions of environmental issues*
- *Because all things are connected, maintaining diversity is critical*

Curriculum Expectations

Science - Grade 6 Understanding Life Systems: Biodiversity

- OE2 investigate the characteristics of living things, and classify diverse organisms according to specific characteristics
- OE3 demonstrate an understanding of biodiversity, its contributions to the stability of natural systems, and its benefits to humans
- SE2.1 follow established safety procedures for outdoor activities and field work
- SE2.4 use appropriate science and technology vocabulary, including classification, biodiversity, natural community, interrelationships, vertebrate, invertebrate, stability, characteristics, and organism, in oral and written communication
- SE3.5 describe interrelationships within species, between species, and between species and their environment and explain how these interrelationships sustain biodiversity

Social Studies – Grade 6 People and Environments: Canada's Interactions with the Global Community

- OE B2 **Inquiry:** use the social studies inquiry process to investigate some global issues of political, social, economic, and/or environmental importance, their impact on the global community, and responses to the issues (FOCUS ON: *Cause and Consequence*)
- OE B3 **Understanding Context:** describe significant aspects of the involvement of Canada and Canadians in some regions around the world, including the impact of this involvement (FOCUS ON: *Significance; Patterns and Trends*)

- SE B2.1 formulate questions to guide investigations into global issues of political, social, economic, and/or environmental importance
- SE B2.5 evaluate evidence and draw conclusions about global issues of political, social, economic, and/or environmental importance, their impact on the global community, and responses to the issues
- SE B3.1 identify some of the major ways in which the Canadian government interacts with other nations of the world
- SE B3.5 identify some significant political, social, and economic interactions between Canada and other regions of the world, and describe some ways in which they affect these regions

Learning Goals

- At the end of this lesson, students will be able to model the interrelationships between organisms of different trophic levels.
- At the end of this lesson, students will have modeled the interdependence of all living things and the negative consequences when any living organisms are removed from the web of life.
- At the end of this lesson, students will be able to draw a diagram and write a paragraph illustrating the concepts of interrelationships and interdependence, and explain how they sustain biodiversity.
- At the end of this lesson, students will be able to make the connection to how important Canadian decisions are to global environmental ecology.

Instructional Components and Context

Readiness

- Prior knowledge of the trophic levels: producer (plants), primary consumer (herbivores), secondary consumers (omnivores, carnivores), tertiary consumer (carnivores)

Materials

- Index cards, at least one per student
- Coloured markers
- A ball of string

Terminology

- interrelationships
- energy
- food web
- food chain
- producer (plants),
- primary consumer (herbivores)
- secondary consumers (omnivores, carnivores)

- tertiary consumer (carnivores)
- niche
- interdependence

Minds On

Safety for outdoor work must be discussed with the class. (See Safety section in Overview.)

The teacher takes one index card for each student. A coloured circle is drawn in one corner.

Possible colours (for a sample class of 20)

- Green: producers - 8
- Orange: herbivores - 5
- Brown: omnivores - 4
- Red: predators/ carnivores - 2
- Yellow: Sun – 1

Students choose a card randomly. They will draw a picture of any Canadian organism that fits the niche of the colour they chose and that could be found within their local biome. One of the omnivores should be drawn as a human.

The student attaches the card to a string that will fit over the neck so that hands are free and the class can see the picture. Alternatively, masking tape will work.

Connections

Assessment for learning

Assess understanding of terms such as producer, consumer, and concepts such as niche by the animals or plants students draw to represent these trophic levels.

Differentiated Instruction

Pair students at different levels of understanding so they can benefit from each other. Encourage student interaction and help those that have difficulty deciding what animal or plant to be. Have several pre-made cards available.

Action

Outside, the students stand in a circle. A ball of string is given to the sun. The sun says, "I am the sun. I give energy to ". This student names the plant or animal and throws the ball to that student while holding on to the end . That student catches the ball and says, "I am a daylily (or whatever has been drawn on the card) and I give energy to....". The ball is then thrown to something that eats what was on the card. That student holds on to the string as it is thrown. The sentence could also be, "I get energy from...".

This continues until a beautiful web is formed connecting every student. The sun, since it is connected to everyone, is always there to throw the ball to if the student is not sure where to throw it.

At the end, questions are asked of the group, such as, what did we make?; what are the connections?; what would happen if all the herbivores were gone from this ecosystem? (Let the herbivores drop their strings – the web is damaged.) You can do this one group at a time and let students see the interrelationships between each group and the interdependence of all groups to each other.

Connections

Assessment as learning

Anecdotal observations of the students' questions will help the teacher assess learning during the outdoor activity. Teachers may ask, "What do you eat for energy?" or "What eats you?" to get them thinking. Observations of the students' reactions when the web starts to fall apart when trophic levels are dropped will also help teachers assess whether the concepts of interrelationships and interdependence are grasped.

Differentiated Instruction

Students that have trouble deciding who to throw the ball of string to may need extra help or support from teacher-lead inquiry. Observation of student questions and hesitation to throw the ball of string will be a helpful assessment of help needed.

Physically disabled students may be paired with a student who can help them throw the ball if needed. Wheelchairs can be incorporated in the circle.

Consolidation

After the string is rolled up, the students will gather for group reflection on the activity, such as a Knowledge Building Circle (instructions and examples can be found in Natural Curiosity, 2011).

The students will draw the food web and write a paragraph about what happened to the web as organisms were dropped. In their paragraph, the students should explain how the connections between the organisms allowed a variety of plants and animals to exist.

Connections

Assessment as or of learning

Assessment of the connections drawn to reflect understanding of interrelationships and interdependence. The paragraph will give further insight into the application of interdependence and how interrelationships sustain biodiversity.

Differentiated Instruction

This section is cross-curricular with art. Some students may not be confident in their artistic ability. Emphasize that assessment is not going to reflect artistic ability, rather understanding the interrelationships between organisms and the sun as sources of energy. Scaffolding of the food web can occur through making food chains of three organisms first, and then developing these chains into a more complicated food web. For some students, a computer could be used to access various types of graphic organizers or the Inspiration program.

Extension

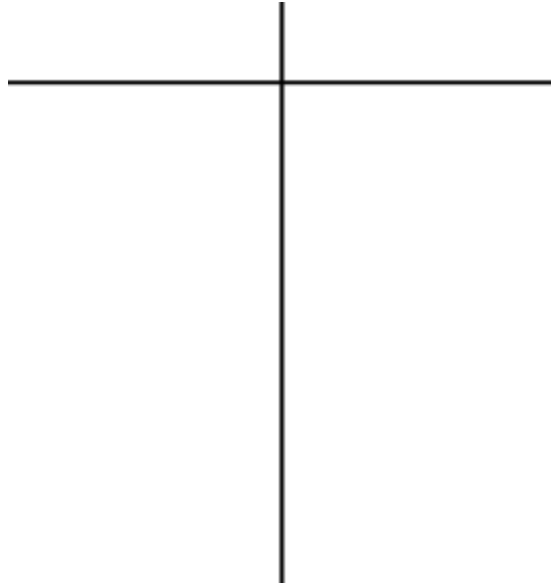
In the Knowledge Building Circle or class discussion, relate the concept of interrelationships to relationships that Canada has with the rest of the world that affect the global environment. Ask the question, "How do the actions of Canadians affect the air, water, land or resources of other countries?"

Divide class into small groups of three or four students. Give each group newspaper clippings or access to the internet to look up current environmental issues, such as acid rain, overfishing, etc. Ask each group to create a T - chart entitled, "The Ways Canadians Affect the Environment of Other Countries". One side of the T will be positive effects and the other side will be negative effects. Instruct each small group to come up with two effects on each side. Sample chart:

The Ways Canadians Affect the Environment of Other Countries

Positive Effects

Negative Effects



Sample answers could be:

Positive: Canada uses renewable forms of energy such as wind, solar, hydro to obtain energy so that less carbon dioxide is released into the atmosphere. The government has anti-pollution laws that keep factories from dumping chemicals into the waterways which eventually go into the water in the oceans which other countries use. Canadian scientists have developed cars that use alternative fuels other than only gasoline. When Canadians reduce chemicals from their factories, they reduce pollution that influences other countries through acid rain. People use less plastic bags so there are fewer in the ocean to harm fish and aquatic animals.

Negative: Canadian factories dump pollutants into Lake Ontario which travels into the Atlantic Ocean. Canadian fisheries are depleted from overfishing which affects other countries' fish population. Canadian people use a high percentage of fossil fuels for cars and industry which affects climate change, especially in the arctic.

Assessment as and of learning:

"I can" statements - Students write "I can" statements concerning their understanding of interrelationships in four categories:

Knowledge of Terms, Communication and Expression of Ideas, Thinking and Planning Skills, and Applying Concepts

Sample ICE Rubric:

ICE Rubric for Interrelationships

Element/Categories	Ideas Level 1	Connections Level 2	Extensions Level 3	Extensions Level 4
Knowledge/ Understanding	I can give a basic definition of interrelationships	I can connect the concept of food chains to interrelationships	I can show how countries are related to each other	I can make suggestions as to how I, as a Canadian citizen, can have a positive relationship to others
Communication	I can ask questions in the Knowledge Building Circle	I can communicate how all living things are interrelated with specific examples	I can explain how and why my thinking has changed	I can ask new questions about interrelationships between Canadian citizens and other countries
Thinking/Investigation	I can think of other organisms I could be connected to in the web of life game	I can explain how I am connected to other organisms	I can apply interrelationships to Canada and think of ways we as a country could make wise environmental decisions	I can encourage others to live in a way that will help Canada save energy and not be a negative influence
Application	I can make a simple web of life concept map	I can connect all the organisms in a web of life concept map	I can make a T chart of positive and negative effects Canada has on other countries	I can explain to others how Canada can have a more positive effect on other countries

(Ideas from Natural Curiosity, 2011, pg 33)

Grade 6 Biodiversity

Lesson 3 - Create Your Own Creature: A Lesson Celebrating Diversity

Lesson Overview

This activity will develop the concept of organism diversity within classification systems and the understanding of the variety of life on earth among the physical landscapes that support them. The lesson is cross-curricular with art as students use their imaginations and art materials to create a unique creature with characteristics that can be classified. The activity is divided into three 60 minute sessions.

Connections to Environmental Education

- *The earth's physical and biological systems*
- *Because all things are connected, maintaining diversity is critical*

Curriculum Expectations

Science - Grade 6 Understanding Life Systems: Biodiversity

- OE2 investigate the characteristics of living things, and classify diverse organisms according to specific characteristics
- SE2.1 follow established safety procedures for outdoor activities and field work
- SE2.3 use scientific inquiry/research skills to compare the characteristics of organisms within the plant or animal kingdoms system
- SE2.4 use appropriate science and technology vocabulary, including classification, biodiversity, natural community, interrelationships, vertebrate, invertebrate, stability, characteristics, and organism, in oral and written communication
- SE2.5 use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes
- OE3 demonstrate an understanding of biodiversity, its contributions to the stability of natural systems, and its benefits to humans
- SE3.1 identify and describe the distinguishing characteristics of different groups of plants and animals,
- SE3.2 demonstrate an understanding of biodiversity as the variety of life on earth, including variety within each species of plant and animal, among species of plants and animals in communities, and among communities and the physical landscapes that support them

Learning Goals

- At the end of this lesson, students will have researched specific distinguishing characteristics of different species of the animal kingdom, including those that help to classify them in their kingdom and that influence their survival in the specific physical landscape in which they live, such as protective colouration, camouflage, etc.
- At the end of this lesson, students will have created their own creatures, which they think could survive in an outdoor habitat, utilizing the information they have discovered through their research.
- At the end of this lesson, students will test their hypothesis by hiding their creature in the outdoors in a type of “hide and seek” game.

Instructional Components and Context

Readiness

- Prior knowledge of how to research animal characteristics

Materials

- Vegetables of various shapes and sizes, such as potatoes, carrots, turnips, enough for each student to have one
- Various colours of acrylic or tempera paint
- Paint brushes of various sizes
- Toothpicks
- Pipe cleaners
- Google eyes
- Dry pasta of different types
- Cotton balls
- Yarn
- Glue
- Masking tape
- Popsicle sticks
- Plasticine
- Newspaper
- Timer
- Observation cards

Terminology

- vertebrates
- invertebrates,
- animal kingdom
- camouflage
- protective colouration
- characteristics

- arthropod
- crustacean
- chordates

Minds On

Lesson 1: This research, using online and written resources, can be done in class or at home.

Whole class:

Instruct students regarding safety precautions for outdoor activities. (See introduction pages)

Partner groups:

Students will be divided into two teams. Within the groups, partnerships will be formed. Partners will choose a specific class of organism within the animal kingdom to research for characteristics that classify them. (For example, if arthropods are chosen, research will be done that reveals insects have six legs and three body parts. If amphibians are chosen, research will be done that reveals smooth moist skin. If mammals are chosen, research would reveal fur covering their body, etc.) Partners will also research characteristics that show diversity among animals that help equip them for survival in their habitat, such as protective colouration displayed in mimicry or camouflage.

Lesson 2: Cross-curricular with art: This can be done either indoors or outdoors, but outdoors is suggested.

Using their research, partners will collaborate to design their own creature with characteristics that are found within their specific class of organisms. It is not expected to look exactly like a particular living organism; it is to be their own creation. This would be a good time to teach about the number of species presently known and being discovered; scientists have counted 1.9 million species of an estimated 11 million. The number of newly discovered species continues to grow; for example, 114,000 were discovered between 2006 -2009. (National Geographic, 2011, pg 5)

Students will create their creature with the materials provided, and let them dry.

Connections

Assessment for learning

Research results and choice of animal can help the teacher assess prior understanding of the diversity of animals

Assessment as learning

Teacher anecdotal observations of design and implementation revealing knowledge of characteristics specific to classification groups in lesson 1 and 2.

Differentiated Instruction

Pair students at different levels of understanding so they can benefit from each other. If students are not ready to go outside, use flash cards or a word wall for vocabulary before the outdoor observation begins.

Action

Lesson 3: This lesson occurs outdoors.

The two teams are assigned different sections of the school yard, close enough that they can be supervised, but far apart enough that the groups cannot see each other. The teacher must clearly set the boundaries and give clear instructions about how high the creatures may be placed, for example, not over one metre.

The partner groups choose appropriate hiding spots for their creatures. They may not bury them completely or conceal them; a small portion must be visible from close proximity. The physical surroundings should be sufficient to hide them. At least 10 -15 minutes should be allowed for this part. When they are finished hiding their creatures, they are to return to a neutral zone where the teacher is waiting.

When everyone has hidden their creatures and returned to the teacher, a timer is set for a designated time (approximately 15-20 minutes should be sufficient, but this can be modified by the teacher as desired). The students are instructed to go into the other team's territory to look for the creatures, but they **MAY NOT TOUCH OR MOVE THEM**. Each partner group is given an observation card to record the creatures they can find by writing on their observation cards the details about the creature that they can see, the location description, what class they think the animal is part of, what characteristics helped them classify it, what helped them find it, and what worked to make it hard to find. (See sample observation card.)

When the time is up, a whistle is blown or a bell rung to gather students back to the neutral zone.

The students reveal which creatures were found. If one was not found, the group is led by the creators to show them where it is. The students now go back to their area to retrieve their creatures.

Connections

Assessment as learning

Teacher anecdotal observations of collaboration and team support in hiding and searching for creatures in lesson 3.

Questions asked about choice of location to hide animals will reveal the understanding of the interrelationships between the organism and the physical environment it lives in.

Consolidation

Students gather in a circle (either outdoors or indoors) and share what they recorded on their observation cards, what they have learned, and what questions they have. A good suggestion for this type of circle is the Knowledge Building Circle described in *Natural Curiosity*, pgs. 21-30.

Students will hand in observation cards to the teacher.

Connections

Assessment as learning

Use of terms and understanding of biodiversity concepts during Knowledge Building Circle will help teacher and student assess learning of the necessity of diversity.

Assess achievement category Thinking and Investigation (T/I) as they are outside for inquiry (questions asked), and the depth of investigation.

Anecdotal observations of the students' observations and the questions they ask will help the teacher assess learning during the outdoor activity.

Differentiated Instruction

Students that have trouble identifying classes of organisms or finding evidence to write on their card may need extra help or support from teacher-lead inquiry. Observation of student questions will be a helpful assessment of help needed.

Students with accommodations and/or modifications could be paired with another student or need a scribe.

Sample observation card:

Description of creature	Hypothesis for biodiversity classification	Characteristics that were used to classify the creature	Description of the habitat it was found in	Factors that helped to find it or that made it harder to find

Resources

Lanting, Frans, *BIODIVERSITY The Web of Life That Supports Us All*. Supplement to National Geographic Magazine, National Geographic, January 2011.

Natural Curiosity, The Laboratory School at the Dr. Eric Jackman. Institute for Child Study, University of Toronto, OISE, Oshawa, ON 2011

Project Wild, Canadian Wildlife Federation

OBIS Outdoor Biological Instructional Strategies, Invent an Animal Activity,
<http://www.outdoorbiology.com/node/54>.

Grade 6 Biodiversity Unit

Lesson 4 - Virtual Collections: A Classification Activity

Lesson Overview

Technology and biodiversity expectations are incorporated in this outdoor activity that enable students to classify organisms. Students will take pictures of a variety of living organisms, classify them, and display them in an area of the school where others can learn and enjoy them.

This is a three part lesson that will require approximately 3 hours.

Connections to Environmental Education

- *The earth's physical and biological systems*
- *The scientific and human dimensions of environmental issues*

Curriculum Expectations

Science - Grade 6 Understanding Life Systems: Biodiversity

- OE2 investigate the characteristics of living things, and classify diverse organisms according to specific characteristics
- SE2.1 follow established safety procedures for outdoor activities and field work
- SE2.2 investigate the organisms found in a specific habitat and classify them according to a classification system
- SE2.3 use scientific inquiry/research skills to compare the characteristics of organisms within the plant or animal kingdoms (sample guiding questions)
- SE2.4 use appropriate science and technology vocabulary, including classification, biodiversity, natural community, interrelationships, vertebrate, invertebrate, stability, characteristics, and organism, in oral and written communication
- SE2.5 use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes (e.g., use a graphic organizer to show comparisons between organisms in various communities)

Social Studies – Grade 6 People and Environments: Canada's Interactions with the Global Community

- OE B3 **Understanding Context:** describe significant aspects of the involvement of Canada and Canadians in some regions around the world, including the impact of this involvement (FOCUS ON: *Significance; Patterns and Trends*)

Learning Goals

- At the end of this lesson, students will have explored different ecosystem communities for diversity and taken pictures of organisms that illustrate specific characteristics that helped the students classify them.
- At the end of this lesson, students will have developed a classification system and collaborated with classmates to classify the pictures they have taken.
- At the end of this lesson, students will have produced a photography exhibit to display their photographs within classification groups.

Instructional Components and Context

Readiness

Students will know how to operate a digital camera. Students will have a basic understanding of the characteristics that determine whether an organism is plant or animal, such as mammal, bird, reptile, amphibian, fish, insect, etc.

Materials

- Digital cameras - enough so that the class can have one per every two students
- (Students will be asked to bring their own cameras in addition to school cameras that are available.)
- iPads (optional)

Terminology

- classification
- characteristics
- organisms
- vertebrates
- invertebrates
- chordates
- flowering plants
- coniferous trees
- deciduous trees
- mosses
- ferns

Minds On

Whole class: (30 minutes)

Preparation:

Safety for outdoor work must be discussed with the class. (See Safety in Overview section)

A previous lesson using the two sites listed below in resources or other picture books should give students a basic understanding of characteristics found in different taxonomic groups.

Think-Pair- Share:

The students will work with a partner to come up with a list of characteristics of organisms that would be helpful to classify them into groups. For example, moving, non-moving, wings, no wings, skeleton on the outside, skeleton on the inside, producer, consumer, fur, feathers, number of legs, no legs, cones, flowers, etc. Pictures of various plants and animals could be made available so students can get ideas of characteristics. They will write one characteristic per post-it note and write as many notes as they can within ten minutes.

The partner groups will share the ideas they have on post-it notes with the class by bringing the notes up to the board.

The class will work together to group the characteristics in a way they think would make sense. For example, under a heading “mammal”, characteristics such as fur, multiple legs, skeleton inside the body would be placed. Guiding questions that could be asked by the teacher are:

1. What are the criteria you will use to group characteristics?
2. Why are these good criteria to use?

Connections

Assessment for learning

Assess readiness to go outside by the number and quality of characteristics the groups came up with.

Assess understanding of classification concept by choices made in grouping organisms. The teacher can use the students’ choices to assess prior knowledge of classification concepts.

Differentiated Instruction

Pair students at different levels of understanding so they can benefit from each other. If students are not able to group characteristics, refer them to the pictures available to show what a mammal, bird, coniferous tree, flowering plant, etc., look like before the outdoor activity begins. A template could be prepared and used matching a picture with a category.

Action

(viewing Canadian photography, 15 minutes; at least two 30 minute sessions outdoors)

Show samples of Canadian Nature Photographer's work to demonstrate the skill of capturing wildlife and plants with photography and the positive influence Canadians have on helping people value natural areas. Use Robert Bateman website as a resource for a Canadian nature artist.

<http://www.robertbateman.ca/kids/GetToKnowPage.htm>

Each partner group will be given a camera. The class will go outside and visit at least two outdoor areas in the schoolyard, community, natural area, etc. The students will take turns taking pictures of as many diverse organisms as possible, trying to find and capture some of the characteristics written in the class.

Connections

Assessment for learning

Anecdotal observations of the students' observations and the questions they ask will help the teacher assess learning during the outdoor activity.

Differentiated Instruction

Students that have trouble finding organisms to photograph may need extra help or support from teacher-lead inquiry. Observation of student questions will be a helpful assessment of help needed.

Consolidation: (30 minutes)

Back in the classroom, partner groups will join with another group to make small groups of four to share their photographs. Together they will decide which ones they will save to have printed. The criteria for saving are:

- Clear, easy-to-see characteristics
- Diversity of organisms within the small group (not all pictures of a worm, for example)

Each student may print 3 pictures, so each group of 4 will have 12 pictures.

The teacher will develop or print the pictures chosen and bring them to class.

The next class: (60 minutes)

Students will frame their pictures with mat board or construction paper. The visual arts teacher may be consulted for this step.

The small groups of four will use the characteristics to classify each picture according to the classification groups formed on the board in the previous lesson.

Guiding questions the teacher could ask are:

- What characteristics will you use to classify your picture?
- Why is it important to be able to compare organisms in some organized way?

Students create signs to place on the wall in the hallway or classroom of classification groups and arrange their pictures around these classifications.

This could be a part of a larger science or art exhibit, or parents could be invited in during an open house or evening event to view the nature art exhibit.

Connections

Assessment for learning

Triangulation of evidence for learning assessment will be:

- observation of students' process of choosing photos and working together in groups to classify pictures;
- anecdotal observation of student questions throughout the process or informal teacher-student conferences about photos and the classification process;
- assessment of the photo display and the classification group chosen.

Differentiated Instruction

When students share their photos, some students may be hesitant. Teachers can be present and circle the room as students talk about their pictures, and offer support and encouragement. Instruction to the whole group about encouraging words and the beauty of individual art would be helpful.

Resources

Classification Pictures:

Kidport reference Library, Kidport, 1998-2012.

<http://www.kidport.com/reflib/science/animals/animalindexv.htm>

http://www.biology4kids.com/files/plants_main.html

Canadian Photographers Websites:

<http://www.canadiannaturephotographer.com/featuredphotographer.html>

Wildflowers in the **Canadian** Rockies - <http://www.canadiannaturephotographer.com/halleflygare.html>

Marriot, John, <http://www.wildernessprints.com/>

Robert Bateman - <http://www.robertbateman.ca/kids/GetToKnowPage.htm>

Rader, Andrew, Biology 4 Kids: Plants, Andrew Rader Studios, 1997-2012

Grade 6 Biodiversity

Lesson 5 - Miniature Investigative Nature Trail

Lesson Overview

This activity will bring the students outside and give them an opportunity to investigate an outdoor environment, design and implement a miniature nature trail, and communicate their findings of organisms to others.

This activity should be used to develop the concept of classification and allow students to use their knowledge of classification gained in previous lessons to classify the organisms found. (See the virtual collections lesson for an example of a lesson teaching classification.)

This activity will allow all students, including students with special needs, to have an opportunity to explore the natural world as mandated in the Ontario Ministry curriculum guidelines for the Grade 6 Biodiversity unit.

The Social Studies Big Idea that states, “The actions of Canada and Canadians can make a difference in the world”, is addressed in the extension of this activity as students compare the positive and negative consequences that human activity can cause along their nature trail. The extension section is also cross-curricular with art and technology.

The time required without the extension is 120 minutes.

Connections to Environmental Education

- *The earth’s physical and biological systems*
- *The scientific and human dimensions of environmental issues*
- *Because all things are connected, maintaining diversity is critical*

Curriculum Expectations

Science - Grade 6 Understanding Life Systems: Biodiversity

- OE2 investigate the characteristics of living things, and classify diverse organisms according to specific characteristics
- SE2.1 follow established safety procedures for outdoor activities and field work
- SE2.2 investigate the organisms found in a specific habitat and classify them according to a classification systems
- SE2.4 use appropriate science and technology vocabulary, including classification, biodiversity, natural community, interrelationships, vertebrate, invertebrate, stability, characteristics, and organism, in oral and written communication
- SE2.5 use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes
- OE3 demonstrate an understanding of biodiversity, its contributions to the stability of natural systems, and its benefits to humans

- SE3.1 identify and describe the distinguishing characteristics of different groups of plants and animals
- SE3.2 demonstrate an understanding of biodiversity as the variety of life on earth, including variety within each species of plant and animal, among species of plants and animals in communities, and among communities and the physical landscapes that support them

Social Studies – Grade 6 People and Environments: Canada’s Interactions with the Global Community

- OE B3 **Understanding Context:** describe significant aspects of the involvement of Canada and Canadians in some regions around the world, including the impact of this involvement (FOCUS ON: *Significance; Patterns and Trends*)

Learning Goals

- At the end of this lesson, students will have investigated organisms of different kingdoms and noted characteristics.
- At the end of this lesson, students will have designed and implemented a miniature nature trail highlighting the biodiversity of the area studied.
- At the end of this lesson, students will have communicated what they have learned about their nature trail in the form of a nature guide and shared their guide with others.

Instructional Components and Context

Readiness

Prior knowledge of the difference between the plant, animal, and fungi kingdoms, knowledge of classification and basic characteristics that they can use to classify organisms, knowledge of habitats and ecosystems

Materials

- Construction paper of several colours (one colour per group)
- Toothpicks or popsicle sticks (depending on how large your triangle flags will be)
- Glue or tape
- Markers
- Copy of record sheet below
- Pencil for each student
- Lab notebook for writing terms and taking notes from the field
- iPad for making notes and taking pictures (optional)
- Laminator or contact paper
- Non-permanent markers

Materials for extension

- Markers
- Pencil crayons
- Camera
- Materials to build trail, such as wood, hammers, nails, etc.

Terminology

- vertebrates
- invertebrates
- classification of kingdoms (plant, animal, and fungi kingdoms)
- characteristics
- organisms
- natural community
- flowering plants, cone-bearing plants
- moss
- algae
- lichen

Minds On

Whole class or small group preparation work: (15 minutes)

Safety for outdoor work must be discussed with the class. (See Safety in Overview section.)

The students should make a list of terms on the board of previous vocabulary learned in the unit that includes, but not limited to, the terms listed above under terminology. This could be done as a cooperative learning activity with small groups using post-it notes and then bringing the notes to the board as a concept map. It could also be done as a large group activity where the teacher puts the three kingdoms up on the board or screen and the class suggests examples or related terms. Another possibility is a word wall, where terms are introduced and placed on the wall as the unit progresses. Students will write the terms listed in their notebooks to refer to while outside.

Partner work: (this step could be done indoors or outdoors) (15 minutes)

Students will work in partners to create eight nature trail markers from toothpicks and coloured triangle paper, marked with numbers. Instructions for students:

- a) Cut triangles out of coloured paper that have a flag-like shape. Each partner group will have one colour.
- b) Wrap the short side of the triangle around the toothpick or popsicle stick, and glue or tape it around the stick.
- c) Write a number from one to ten on each flag trail marker.

(These steps should occur outside.) (40 minutes)

Students will go outside, either in the schoolyard or a spot chosen by the teacher in a natural area, bringing their triangular markers and their notebooks. Each pair of students will choose their own area to mark out their nature trail. The areas should include different ecosystems to increase diversity of items discovered, i.e., sidewalk, grassy area, wooded area, etc. However, areas must be situated so that all students can be seen by the teacher.

Students will bring their trail markers and a notebook to take notes on the interesting nature places they want to mark along their trail (i.e., a particular habitat, such as an ant hill; an abiotic item, such as a cool rock that has algae, lichen or fungi on it, or serves as a habitat for various invertebrates; a hole in a dead tree; a beautiful wildflower; a coniferous tree; etc.). The students should use the terms introduced in the unit that they have written in their notebooks to describe what they find. Students should try to find items that come from at least three different kingdoms: plant, animal, and fungi. Partners will collaborate and choose eight places to put their markers.

Connections

Assessment for learning

As students write terms from their unit, the teacher may assess prior knowledge and understanding of the terms.

Assessment as learning

Anecdotal observations can be made of students' observations and selections of items to mark on their trail. The teacher may want to ask questions for the students to consider, such as, "What interests you most about this area?"; "What can help you decide which kingdom this item is in?" As students ask and answer questions, the teacher can assess learning.

Differentiated Instruction

Pair students at different levels of understanding so they can benefit from each other. If students need more time to learn the terms before they use them outdoors, work with the word wall or flash cards may be helpful. The teacher can make flash cards with pictures and laminate them to be brought outside for English Language Learners.

Action (20 minutes)

Students will place a trail marker at each spot, making sure that they have notes about the spot in their notebook that is detailed enough and uses terms learned in the unit in order to write a clue for another pair of partners to identify what the marker represents and what classification group can be found there. (Example of a level 4 clue that a student could write: "This is an organism that provides shelter for invertebrates and vertebrates, and provides nourishment for algae and lichen. It has cones that have seeds in them. If you look closely, you will find ants and beetle larvae on it.") Clues should include specific characteristics that show unique properties from the other items marked on their trail and information that will help the observing group to identify the kingdom it is part of.

Step #7 can be done inside or outside as well, according to the teacher's preference. (30 minutes)

Student pairs will be given a copy of the "Nature Detective Sheet" so they can write clues that give detailed information about specific characteristics of the item corresponding to the marker on their nature trail. This will be written in the column labelled Part A. (See template below.)

Students give their Nature Detective Sheet to another partner group to take to the nature trail to identify the items and their kingdoms. The partner group reads the clues and writes what they can discover about the item, naming it and identifying the kingdom the item is part of, and records their information in Part B on the Nature Detective Sheet.

Connections

Assessment for learning

Knowledge/Understanding: Terms and descriptions in the clues and in the information added by the second group will reveal understanding and knowledge of biodiversity concepts.

Thinking/ Investigation: Teacher observation and anecdotal comments recorded as students investigate and design their miniature nature trail, and as students investigate clues to identify the marked item.

Communication: Writing the clues for their Nature Detective Sheets will reveal ability to communicate what they have observed and learned. Were the clues easy to follow? Could the second partner group successfully understand the clues? Was the second partner group (Part B) able to communicate why they chose the kingdom they decided on?

Application: Questions asked by students reveal application of biodiversity expectations. For example, if a student asks, “Why does this moss not have seeds like this wildflower?” or “Is competition happening between these two species because this type of flower seems to be taking over, but this type does not grow as well?”, this shows application of structural differences that could be used for classification or application of invasive species competition.

Differentiated Instruction

Students collaborate together to write observations and clues. The guide that is produced has several checkpoints before the final product is ready. It is peer-evaluated, given to the teacher to assess, tried out by peers. This should help students who are unsure of their work or need extra assistance.

Consolidation (30 minutes)

All students return to the classroom or designated outdoor meeting place and share their findings on the Nature Detective Sheets. A Knowledge Building Circle could occur where students share how they came to their conclusions or ask questions of the other partner groups.

The Nature Detective Sheets are given to the teacher to evaluate. Extension ideas follow.

Sample template for Nature Detective Sheet:

Trail colour: Marker Number:	Part A: Clues about the marked item with specific characteristics that will help identify its kingdom.	Part B: What is it? What kingdom does it belong to?
1		Item: Kingdom:
2		Item: Kingdom:
3		Item: Kingdom:
4		Item: Kingdom:
5		Item: Kingdom:
6		Item: Kingdom:
7		Item: Kingdom:
8		Item: Kingdom:

Extensions: (60 minutes)

After the Nature Detective Sheet has been proven successful by student use, the original students who wrote the clues may incorporate the information given by the second student group, and make a final copy on a clean sheet without filling in the Part B column. This final copy can be illustrated, have pictures added from a camera, decorated with graphics, etc. In this way, this lesson will be co-curricular with art and technology. It should be laminated so other students could write their answers in Part B with non-permanent ink and check it with an answer key made by the original students. The paper markers could be replaced with more permanent markers.

Each student could write up a story about their nature trail that involves a scenario involving human influence along their trail. Both positive and negative human influence should be compared. This would be co-curricular with the social studies big idea: The actions of Canada and Canadians can make a difference in the world. Examples of the actions of Canadians to preserve natural areas and harm natural areas can be developed.

For instructions to guide students in building a permanent nature trail, see the article, *Trail Blazers*, by Lisa Marie Conners (see reference list).

Differentiated Instruction

Kinesthetic learners will do well with the exploration, art and technology aspect of this lesson. If the extension is done that involves artwork or photography, students with special artistic interests could be given leadership on this section of the assignment. Collaboration throughout the project will assist learners with special needs.

Assessment as or of learning

Assessment of learning regarding all four achievement categories can be done of the nature trail itself, the appropriateness of the choices of items, and the finished guide that others can use and learn about the nature trail.

Knowledge and Understanding can be demonstrated through use of terms and identification of organisms within kingdoms.

Thinking and Investigation can be demonstrated by discovery of appropriate items and exploration of the diversity of the natural area the students are working in.

Communication can be demonstrated through the written guide that the students develop and the clarity of the clues described on the guide.

Application can be demonstrated by the development of clues and application of concepts of diversity and classification. Level 4 trail guides will include comments that show the importance of the diversity of the area.

If extensions are done:

Assessment of learning: If students write up a story about their nature trail; interdisciplinary with English skills, a rubric or rating scale could be made. (See sample rubric at the end of this lesson.)

Sample Rubric:**Assessment of Learning Rubric for the Miniature Nature Trail**

Category	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	The student has limited use of vocabulary words from the unit	The student demonstrates some use of vocabulary words from the unit	The student has limited use of vocabulary words from the unit.	The student has limited use of vocabulary words from the unit.
Thinking and Investigation	The student found limited items to mark on the nature trail	The student found some items to mark on the nature trail	The student found many interesting items to mark on the nature trail	The student found a high degree of diverse and interesting items to mark on the nature trail
Communication	The nature guide questions were limited in their effectiveness	The nature guide questions were somewhat clear in their effectiveness	The nature guide questions were clear and interesting	The nature guide questions were thought provoking and very interesting
Application	The nature guide was limited in illustrating diversity	The nature guide and the story were somewhat clear in illustrating diversity	The nature guide and the story illustrated the concepts of classification and diversity	The nature guide and the story very clearly illustrated the concepts of classification and diversity

Resources:

Conners, Lisa Marie, *Trail Blazers: Fourth-Grade Students Create Digital Field Guides for Visitors to the School's Nature Trail*, Science and Children, v49 n4, pg 46-50, Dec 2011

Web site: <http://www.nsta.org>

Ontario's Biodiversity Strategy: "Protecting What Sustains Us"

http://www.mnr.gov.on.ca/en/Business/Biodiversity/2ColumnSubPage/STEL02_166816.html

Grade 6 Biodiversity

Lesson 6 - Invasive Species Investigation

Lesson Overview

This is a four-part lesson sequence. It introduces the concept of alien and invasive species, and allows students to identify invasive species in their schoolyard and community through an activity that is cross-curricular with physical education. Students research what is being done to control invasive species and have an opportunity to help control them in their schoolyard and community. Students investigate the link to the social studies curriculum by addressing the importance of international cooperation in the issue of invasive species that affects Canadian ecosystems.

The time required for the first three parts is three hours. The extension is variable depending on the location of invasive species.

Connections to Environmental Education

- *The earth's physical and biological systems*
- *The scientific and human dimensions of environmental issues*
- *The positive and negative consequences, both intended and unintended, of the interactions between human-created and natural systems*

Curriculum Expectations

Science - Grade 6 Understanding Life Systems: Biodiversity

- OE2 investigate the characteristics of living things, and classify diverse organisms according to specific characteristics
- SE2.1 follow established safety procedures for outdoor activities and field work
- SE2.4 use appropriate science and technology vocabulary, including classification, biodiversity, natural community, interrelationships, vertebrate, invertebrate, stability, characteristics, and organism, in oral and written communication
- OE3 demonstrate an understanding of biodiversity, its contributions to the stability of natural systems, and its benefits to humans
- SE3.7 explain how invasive species (e.g., zebra mussels, Asian longhorned beetle, purple loosestrife) reduce biodiversity in local environments

Social Studies – Grade 6 People and Environments: Canada's Interactions with the Global Community

- OE B1 **Application:** explain the importance of international cooperation in addressing global issues, and evaluate the effectiveness of selected actions by Canada and Canadian citizens in the international arena (FOCUS ON: *Interrelationships; Perspective*)

- OE B2 **Inquiry:** use the social studies inquiry process to investigate some global issues of political, social, economic, and/or environmental importance, their impact on the global community, and responses to the issues (FOCUS ON: *Cause and Consequence*)
- B2.1 formulate questions to guide investigations into global issues of political, social, economic, and/or environmental importance
- B2.5 evaluate evidence and draw conclusions about global issues of political, social, economic, and/or environmental importance, their impact on the global community, and responses to the issues
- SE B3.1 identify some of the major ways in which the Canadian government interacts with other nations of the world

Learning Goals

- At the end of this lesson, students will have identified invasive species in their own schoolyard and in their community.
- At the end of this lesson, students will have recorded quantitative observations and qualitative observations regarding invasive species in their schoolyard and in their community.
- At the end of this lesson, students will have researched what is being done in their community to control invasive species in their community. (Link to social studies curriculum)
- At the end of this lesson, students will have created a plan to help control invasive species in their schoolyard and in their community.

Instructional Components and Context

Readiness

Prior knowledge of the difference between the animal and plant kingdoms, competition between organisms, necessity of diversity for the resilience and health of the ecosystem

Materials

- Notebooks for recording invasive species observations
- Clothespins
- Plastic streamers of different colours for each relay team

Terminology

- biodiversity
- monoculture
- natural community
- competition
- interrelationships
- invasive specie
- alien species

Minds On

Introduction: (60 minutes)

Part 1: Introduction (Indoors)

Introduce the concept of alien and invasive plant species through one of the following ways:

a) student partners or small groups will research one invasive plant species in Ontario, including whether or not it is alien, what country it came from, how it was transported here, what plants it competes with, and a picture of the invasive plant species

b) PowerPoint presentation, showing pictures of invasive species in Ontario. The introduction should include the global issue of alien species brought into Canada, both unintentional and intentional. Click here for pictures of several invasive species on the Ministry of Natural Resources website:

http://www.mnr.gov.on.ca/en/Business/Biodiversity/2ColumnSubPage/STDPROD_085427.html

c) invite a speaker from a local organization that is working to control alien and invasive species, to introduce the concept of invasive species. See examples listed at the end of this lesson.

Provide students with safety instructions regarding working in an outdoor classroom. Instruction regarding poisonous plants in the area should be given. See suggestions in the Overview section of this document.

Connections

Assessment for learning

Assess student presentations, if this option is chosen, for thoroughness of understanding of invasive and alien species. Assess student questions for readiness to identify invasive species outside.

Differentiated Instruction

Pair students at different levels of understanding so they can benefit from each other. If students are not ready to go outside, use flash cards or a word wall for vocabulary before the outdoor observation begins. Reinforcement with nature guides, pictures, etc., should be available to assist students.

Action

Part 2: Exploration (Outdoors) (45 minutes)

Students will go outside in pairs and locate examples of invasive species. Easy examples found in most schoolyards are: dog-strangling vine, white sweet clover (follow link for picture and information: http://dnr.wi.gov/invasives/fact/clovers_white.htm)

box elder maple: <http://www.mapleinfo.org/htm/boxm.cfm>

<http://goldenhillplants.com>

garlic mustard: <http://www.omafra.gov.on.ca/english/crops/hort/news/hortmatt/2005/10hrt05a4.htm>

purple loosestrife, milfoil ,and others can be found in the websites listed in the resources:
http://www.ontarioinvasiveplants.ca/index.php/other_sites

Students will record both quantitative and qualitative observations of the invasive species in their notebooks.

Connections

Assessment as learning

Teacher should check the student notebooks to make sure they correctly identified invasive species.

Part 3: Relay game (outdoors) (30 minutes)

Students will play a relay race game to help identify the invasive species (cross-curricular with physical education). Detailed instructions for the race are found at the following website:

http://www.weedinvasion.org/pdfs/Identification/weed_identification_relay.pdf

This fun competition requires students to apply invasive species identification skills in a field setting. Each student is given a clothespin with a coloured streamer attached to it. All members of the same team have the same coloured streamers. The race involves students pinning the invasive species with a clothespin that has a streamer attached to it, then running back to tag the next player on their team. The team that wins is the first team whose players have all found and tagged an invasive species. Each team player must find a different plant. At the end of the game, the students go back to the plant they identified and collaborate with the team to confirm that the plants chosen were indeed invasive. Once confirmed, the plant can be removed by the person who found it.

Note to teacher

Make sure that there are more invasive plant species in the area than there are team members, and encourage students to bring their notebooks and use their notes to identify the invasive species. By identifying the invasive species in a natural setting, students will begin to understand the diversity of plants in the area, the competition between the native and invasive species, how environmental conditions, such as soil types, amount of sunlight, etc.

After the relay game, help students see the competition with native species with questions such as, Why do you think these invasive plants can grow so well in this area?; How does the soil or amount of sunlight affect the growth of these species?; Why will it be a problem in our community if these invasive species keep growing without any interference?; How are the increased numbers of invasive species in our local area connected to the decrease of native plants and animals?; Can you find any examples of native plants and animals that have decreased in population in the last 20 years?

Student and Teacher initiated questions can help students relate the field conditions to the growth of the invasive species. When back in the classroom, a Knowledge Building Circle could help students find answers to these questions. If there are still unanswered questions, the teacher should ask, "How can we find the answer to these questions?" Students will be encouraged to look on the internet for answers to share with the class.

Connections

Assessment as learning

Assess achievement category Thinking and Investigation (T/I) while they are outside for inquiry (questions asked), and the depth of investigation. Anecdotal observations of the students' observations and questions will help the teacher assess learning during the outdoor activity. Student success in finding invasive species and collaboration with team members will also be helpful for teachers to observe.

Differentiated Instruction

Students that have trouble identifying or finding invasive species may need extra help or support from teacher- lead inquiry. A walk around the area to give students a chance to see what plants are there before the game starts may be helpful for unsure or hesitant students. Observation of student questions will be a helpful assessment of help needed.

Consolidation

Part 4: Community Action (Indoors and Outdoors)

Students will work in groups of 4 to research organizations in their extended community that are working to control invasive species. The groups will present their information to the class in differentiated ways. For example, they may choose to do a PowerPoint, poster or pamphlet. The requirements for the information presented are:

1. Name of the organization
2. Names of invasive species they are working to control
3. Location of the work (should be in the local community)
4. The negative impact the particular invasive species has on the local environment
5. Opportunities to work with the organization
6. After all the presentations have been given, the class will choose an organization from one of the presentations through teacher-guided discussion and the group that presented the organization chosen will contact them to find out if the class can take a field trip to work with them.

Arrangements will be made for the class to take part in the project of controlling the invasive species.

A journal or illustration of the experience will be written by the students after the field work is completed.

Teacher will assess the group work to present research on organizations that are working to control invasive species. Assessment of actual work in the field and the written response in the student journal or illustration will give opportunity for assessment of learning.

Differentiated Instruction

Teachers will choose research groups with students' strengths in mind. Teachers can offer choices of local organizations to student groups to get them started.

Resources

Written Resources

Peterson, Roger Tory and Margaret McKenny. *A Field Guide to Wildflowers of Northeastern and Northcentral North America*. Boston: Houghton Mifflin Company, 1968. (or newer version)

Spellenberg, Richard. *National Audubon Society Field Guide to North American Wildflowers, Western Region*. 2nd ed. New York: Knopf, 2001.

Weed identification guides from local extension offices or weed control departments of provincial and federal agencies.

Online Resources

http://www.nanaimo.ca/assets/Departments/Parks~Rec~Culture/Parks/invasive_plants.pdf

http://www.toronto.ca/trees/pdfs/Fact_3_Controlling_Invasive_Plants.pdf

<http://www.naturalbiodiversity.org/kids/teachers.html>

<http://www.ofah.org/>

http://www.weedinvasion.org/pg_about.php

<http://www.mnr.gov.on.ca/en/Business/Biodiversity/index.html>

http://www.mnr.gov.on.ca/en/Business/Biodiversity/2ColumnSubPage/STDPROD_068705.html

<http://www.invasivespeciescentre.ca/About.aspx>

<http://www.ontarioinvasiveplants.ca/>

<http://www.wildlifeforever.org/invasive-species?gclid=CKLlk8mIkLICFYk-MgodxxsAHQ>

Personal and Organizational Resources

Paul Abell, Toronto representative of www.aroch.ca, organization for stewardship of resources working in Toronto and neighbouring areas to control invasive species. He will visit your classroom as an introduction to having your students work on a local project with him to control invasive species.

Contact information:

A Rocha Canada

19353 16th Avenue

Surrey, British Columbia V3S 9V2

arocha.ca

Ministry of Natural Resources, Invasive Species Centre, **Terrestrial Invasion Ecology Lab, Algoma University**, contact: Albert King, Forest Management Branch, 705-945-6718., Kevin Hemsworth, Algoma University, 705 -949-2301 ext. 4120.

Greater Toronto Area

Paul Abell, Stewardship Coordinator

647-969-0259

paul.abell@arocha.ca

<http://beatymuseum.ubc.ca/>

The Beaty Biodiversity Museum is a great site to learn about current research happening internationally regarding endangered species. It is located in Vancouver, Canada.

iPad app

- What's Invasive

Grade 6 Biodiversity

Lesson 7 - Biodiversity Garden: A Culminating Task

Lesson Overview

In this culminating task, students will investigate the issue of monoculture systems of agriculture and sustainable agriculture. Students will also develop the concept that biodiversity is crucial for healthy ecosystems. The students will compare the cost and benefits of a monoculture system farm and an organic farm with diversity. Next, they will research, design, and implement plans to build an organic vegetable garden. This task is cross-curricular with the Social Studies big idea that “Many different communities have made significant contributions to Canada’s development”. The end result of this task will allow students to create a vegetable garden that they can tend and harvest. Opportunities to be good stewards of our resources and sharing the harvest with the community will complete the experience. Involve the local community so that the garden can be tended over the summer.

Connections to Environmental Education

- *The earth’s physical and biological systems*
- *The dependency of our social and economic systems on these natural systems*
- *The scientific and human dimensions of environmental issues*
- *The positive and negative consequences, both intended and unintended, of the interactions between human-created and natural systems*

Curriculum Expectations

Science - Grade 6 Understanding Life Systems: Biodiversity

- OE1 assess human impacts on biodiversity, and identify ways of preserving biodiversity
- SE1.2 assess the benefits that human societies derive from biodiversity and the problems that occur when biodiversity is diminished.
- OE2 investigate the characteristics of living things, and classify diverse organisms according to specific characteristics
- SE2.1 follow established safety procedures for outdoor activities and field work
- SE2.4 use appropriate science and technology vocabulary, including classification, biodiversity, natural community, interrelationships, vertebrate, invertebrate, stability, characteristics, and organism, in oral and written communication
- SE2.5 use a variety of forms to communicate with different audiences and for a variety of purposes
- OE3 demonstrate an understanding of biodiversity, its contributions to the stability of natural systems, and its benefits to humans
- SE3.1 identify and describe the distinguishing characteristics of different groups of plants and animals
- SE3.2 demonstrate an understanding of biodiversity as the variety of life on earth, including variety within each species of plant and animal, among species of plants and animals in communities, and among communities and the physical landscapes that support them

- SE3.4 describe ways in which biodiversity within and among communities is important for maintaining the resilience of these communities
- SE3.5 describe interrelationships within species, between species, and between species and their environment

Social Studies – Grade 6 Heritage and Identity : Communities in Canada, Past and Present

- OE A1 **Application:** assess contributions to Canadian identity made by various groups and by various features of Canadian communities and regions (FOCUS ON: *Cause and Consequence; Patterns and Trends*)

Learning Goals

- At the end of this lesson, students will have gained knowledge and understanding of what monoculture system agriculture and sustainable agriculture is and how they are implemented.
- At the end of this lesson, students will be able to compare the cost and benefit of monoculture farming methods and farms that are organic, diverse, and sustainable.
- At the end of this lesson, students will have used thinking and investigation skills to research, design, and implement a plan for an organic vegetable garden in their schoolyard or local community garden.
- At the end of this lesson, students will be able to communicate the understanding they have gained by presenting to the class their research and part of the plan they designed.
- At the end of this lesson, students will apply the concept of sustainable agriculture by creating a garden which contributes food to their families, the school community, and extended community without using fossil fuels, fertilizers or pesticides.

Instructional Components and Context

Readiness

(Words that are in italics are terms that will be defined in the following section.)

Since this is a culminating task, many concepts in the biodiversity unit should be previously introduced. Products and uses of plants for humans, interdependence, food webs, diversity of plants, monoculture and sustainable agriculture are all concepts that are developed and reinforced through this culminating task.

Plants are essential for sustaining life on our unique planet. Of the many *ecosystem services* that plants provide, three of the most important are:

1. serving as food for organisms,
2. providing oxygen through *photosynthesis*,
3. using carbon dioxide to reduce excess greenhouse gasses which increase *climate change*.

Plants are producers in the intricate *food web* which describes the interdependence all consumers have on plants. Humans rely on plants for nutrition, energy for life and metabolism, health, and sustenance. Agriculture refers to farming practices that produce food from plants.

Fifty percent of the oxygen in earth's atmosphere is produced by plants. Living organisms, including plants, need oxygen. The conversion of *solar energy* into *chemical energy* occurs through a process called photosynthesis, which plants have the ability to perform.

Since the industrial revolution, the balance of oxygen and carbon dioxide, illustrated in the *carbon cycle*, has been interrupted through factors such as burning fossil fuels. As a result, the atmospheric carbon dioxide levels have significantly increased, making it one of the most influential greenhouse gasses affecting climate change. Because of their consumption of carbon dioxide, plants are needed to restore and sustain the carbon cycle balance.

Sustainable agriculture is a concept that carries hope for the world that there will be enough food for its ever-increasing population without compromising the well-being of future generations. The goal of sustainable agriculture is to produce enough food while integrating wise practices for the society and environment. By 2050, it is predicted that the world population may rise to 9 billion. (Dunlop et al, 2010) *Food security* is thus a crucial issue for today's population. Modern technology has allowed food availability to increase globally. As an alternative to *monoculture* and other technological agricultural techniques, sustainable agricultural offers a significant food source without negative environmental and economic consequences. Examples of negative consequences of monoculture systems are that the reduction of diversity causes soil and pest problems so that farmers need to apply chemical fertilizers and pesticides which in turn pollute the land, water, and food that they are producing.

Four ways sustainable agriculture is accomplished are as follows:

1. Crop rotation reduces depletion of important nutrients so that synthetic fertilizers are not needed.
2. Using natural predators, such as ladybugs, eliminates pests rather than using chemical pesticides that cause deadly toxins that affect the food chain.
3. Pull weeds out by hand, rather than using petroleum-based machinery which increases the negative effects of climate change.
4. Hire local people which, in turn, benefit the society and economy of the communities involved.

Materials

- Garden tools (shovels, hoes, rakes, trowels)
- Rocks to outline the garden
- Wood for a sign
- Black soil
- Seeds
- Gloves

Terminology

- *ecosystem services* – the benefits provided by sustainable ecosystems to organisms
- *photosynthesis* – a series of chemical reactions that convert energy from sunlight into chemical energy stored in molecules
- *climate change* – long term change in climate that is measureable
- *food web* –graphic organizer that illustrates the interdependence of organisms for food
- *solar energy* – energy that is captured from the sun’s radiation
- *chemical energy* – energy made available through chemical reactions
- *carbon cycle* – the flow of carbon through an ecosystem, including the processes of photosynthesis and cellular respiration
- *sustainable agriculture* – an approach to agriculture production that integrates economics, the environment, and society in meeting the nutritional needs of the world
- *food security* – the state in which all people have access to safe and nutritious food to meet their dietary needs

Minds On

Preparation

Safety for outdoor work must be discussed with the class. (See Safety in Overview section.) Specifically, safe use of gardening tools must be explained and demonstrated.

Permission must be obtained for an area of land on the school property for two small garden plots. If permission is not given, then look for a community garden nearby that you might be able to walk to from the school.

Lesson 1: Focus of Inquiry: Why are plants necessary? 45 min

In a Knowledge Building Circle, students will be encouraged to ask questions and give ideas about why plants are necessary. The teacher could start the discussion with a question such as, What would our world be like without plants? Students will raise their hands and the teacher picks one student. After he or she gives an idea, that student picks the next student who has a hand raised until everyone who wants to speak has had a turn. (The Knowledge Building Circle is explained in *Natural Curiosity*, 2011, pg. 28-29.)

Students will go in partners to create a concept map with the question, “Why are plants necessary?”, in the centre. They will draw lines out to as many reasons about why plants are important that they can think of. The students can come up with a title for their maps such as, “Why We Need Plants”. The concept maps can be displayed on a wall space in the classroom that has a title made by the students.

Students should have mentioned photosynthesis as one of the benefits of plants that provide food and oxygen. The concept of photosynthesis can be reinforced through a fun and interactive game. The game is found at the following website: <http://www.growingthenextgeneration.com/agrium-games/quiz/index.htm>

Connections

Assessment for learning

This lesson provides three opportunities for assessment:

- a) Observation of questions and ideas that the students give in the Knowledge Building Circle about the necessity of plants.
- b) The concept maps drawn by the partner groups. Depth of understanding can be assessed by the number and variety of ideas drawn out from the centre question.
- c) The game has a self-assessment built into it. As the students make a choice, the website voice celebrates the correct answer with cheering. The students have an opportunity to correct it as many times as they want. Teachers can assess the depth of their knowledge by their success on the game.

Differentiated Instruction

The Knowledge Building Circle will help students collaborate ideas and stimulate discussion that they will apply in their concept maps. Working together with a partner or small group to create a concept map will help those who have a hard time thinking of plant uses. The colourful interactive online game with built-in reinforcement will help build confidence in students unsure of the content.

Lesson 2: Inquiry Focus: Comparing monoculture systems on farms to sustainable systems that encourage biodiversity

Time is needed both in class and at home for the research for this lesson: 45 minutes at home, 45 minutes in class.

This lesson will begin with a Knowledge Building Circle with a new question. The teacher can introduce the question by telling the class that they are going to investigate one of the reasons why plants are necessary, e.g., the provision of food. The teacher can begin the discussion with questions such as, “How is food grown in Canada?”; “Are all farms the same?”; “Are there any negative consequences from farming in Canada?” After students have given their ideas, a jigsaw assignment will be introduced where students each take a piece of one of two questions, “What is a monoculture system for farming and what are its advantages and disadvantages?” or “What is a sustainable system for farming that encourages biodiversity and what are its advantages and disadvantages?”.

The questions can be broken into the following smaller questions assigned to small groups. After the student researches his or her part, the information will be presented first to the small group and then to the entire class. Students will keep research journals where their research notes are dated and recorded with references cited.

Jigsaw pieces:

Group One: Monoculture systems

Research question 1: What is a monoculture system?

Research question 2: What is an example of a monoculture system? Give details of the crop produced.

Research question 3: What are advantages of this system? Give examples.

Research question 4: What are the disadvantages of this system? Give examples.

Research question 5: What effect does a monoculture system have on biodiversity? Explain why.

Group two: Sustainable agricultural systems

Research question 1: What is a sustainable agricultural system?

Research question 2: What is an example of a sustainable agricultural system? (Organic farms may fall under this category.)

Research question 3: What are advantages of this system? Give examples.

Research question 4: What are disadvantages of this system? Give examples.

Research question 5: What effect does a sustainable agricultural system have on biodiversity?

Students will share their research in their small group, then the group will edit and organize the presentation together. Each student will prepare a report and present individual research.

Presentation reports will be handed in to the teacher after the presentation is given.

Connections

Assessment as and of learning

Assessment as learning will be assessed as small groups discuss their research and work together to prepare the presentations. Students will assess their own research in their journals.

Assessment of learning will be assessed with a checkbric that has a checklist to ensure all parts of the research are completed and a rubric for the presentation completions. (See sample at the end of this culminating task.) Journals will also be assessed for thoroughness, understanding of the concepts, and application to biodiversity.

Differentiated Instruction

The small groups should be assigned with presentation abilities in mind. Some students may have difficulty grasping the concept of not using technology, such as machinery and pesticides for agriculture, since we live in a technological age. The presentations from student research will help students understand the negative consequences that could result from monoculture and heavy use of machinery. Students may have trouble working cooperatively. This lesson has several types of differentiated instruction activities so students can interact at their own pace.

Lesson 3: Inquiry Focus: What is the difference in the environmental and economic cost between a monoculture system of farming and a sustainable system of farming?

Using the information given in the research reports, students will analyse the cost and benefit of a monoculture farm and an organic farm. Students will work as partners to answer the questions, What do you think the cost of a monoculture farm is both in money and to the environment?; What do you think the cost of an organic farm is both in money and to the environment? The students will make a Venn diagram to illustrate the differences and similarities.

Alternatively, a farmer from both types of systems could be invited to the class to explain the advantages of their type of farming. The students could then make their Venn diagrams. Consider a field trip to different types of farms.

Connections

Assessment as and of learning

The Venn diagram will reveal the understanding of the differences between the two systems of farming.

Action

Lesson 4: Inquiry Focus: Planning and Building an Organic Garden (approximately five 45-minute sessions)

To apply what the students have learned about the benefits of sustainable agriculture, the students will plan, build, plant, and harvest a vegetable garden.

The students will gather for a Knowledge Building Circle to discuss questions, such as,

- What do we need to know to build an organic garden?
- What size do we want it?
- How can we find out how much soil we need?
- What materials will we need?
- What kind of plants will grow well in our climate and soil type?

The students will come up with all the questions that need to be answered, then each student will work with a partner to research the answer to one of the questions. The research will be recorded in the journal started in Lesson 2 and continued throughout this project.

The students will share their knowledge and decide on the course of action with the teacher's approval.

Materials will be gathered

The garden will be built over at least two class periods (time is variable depending on the size of the garden and number of students). It would be good to get parent or community support for the construction. There is an organization called Green Thumbs Growing Kids that works with urban children, youth, and their families to grow fresh foods in the Toronto area. <http://www.kidsgrowing.ca/>

The students will plant, tend, and harvest the garden to benefit their school community and larger extended community.

Connections

Assessment as and of learning

The design made for the garden was a group effort. Teachers can assess the individual work by checking their research and progress journals.

Differentiated Instruction

Group work outdoors constructing the garden will require a variety of skills. Students can participate as they are able. All students will take part in the planting and harvesting of the vegetables.

Consolidation

Many stewardship ideas can flow from this project. Asking students how they would like their efforts to benefit others will open the door for many applications to the big idea that Canadians help communities. Vegetables could be donated to a local food bank; a “garden party” could be organized where neighbours to the school could be invited in to enjoy the harvest. Photographs of the diverse vegetables could be taken and displayed for an art exhibit.

Differentiated Instruction

The project will be a group assignment, first in small groups to gather information, do the research, and then collaborate to present to the class. This will be a tiered assignment where the instructor will decide which parts of the research, and later, which physical tasks each student will benefit from the most.

ELL students will benefit from the hands-on aspect of the concept, which is conducive to natural English conversation and problem solving. Word boards will be used to develop vocabulary.

Considerations for Advanced students:

There are many tasks that will engage the expertise and research skill of an advanced student. The teacher will reinforce this student’s interest and motivation to make calculations, do in-depth research, be team leaders, etc. in the design and construction of the greenhouse.

Assessment of learning:

Sample Checkbric:

Yes

No

Journal research:

Complete with two research topics:

Comparing agriculture types

Garden plan

Research thorough

Sources listed

Presentation and Planning Category	Level 1	Level 2	Level 3	Level 4
Knowledge of content of the types of agriculture systems	Student demonstrates limited understanding of the agricultural system he/she presented	Student demonstrates some understanding of the agricultural system he/she presented	Student demonstrates considerable understanding of the agricultural system he/she presented	Student demonstrates thorough understanding of the agricultural system he/she presented
Initiating and planning skills when contributing to the garden plan	Student made a limited contribution to the garden planning	Student made some contribution to the garden planning	Student made a significant contribution to the garden planning	Student made a thorough and very helpful contribution to the garden planning
The sketch and diagram of the garden	Diagram of the garden had limited effectiveness	Diagram of the garden had some effectiveness	Diagram of the garden had considerable effectiveness	Diagram of the garden had a high degree of effectiveness
Ideas for stewardship of resources/ sharing with community	Student did not show interest in sharing the harvest with the community	Student had some ideas of how to show stewardship and share with the community	Student had considerable interest in showing stewardship and sharing with the community	Student had a high degree of interest in showing stewardship and sharing with the community