



Sustainability of Ecosystems: A Lesson to Support Science 10

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These lessons were developed by the following team of teachers, Elders, and cultural advisors: Yvonne Chamakese, David Hlady, Anna-Leah King, Duane Johnson, Marcia Klein, Lana Lorensen, Sally Milne, Joseph Naytowhow, Lamarr Oksasikewiyin, Stuart Prosper, Ron Ray, Ted View, John Wright, and Laura Wasacase. Support was provided by Dean Elliott from the Ministry of Education, and Margaret Pillay from the Saskatchewan Professional Development Unit.

All resources used in these lessons are available through the Stewart Resources Centre: http://www.stf.sk.ca/services/stewart_resources_centre/online_catalogue_unit_plans/index.html

Information regarding the protocol when inviting Elders into the classroom can be found in the document: *Elders in the Classroom* by Anna-Leah King (attached as Appendix A). Further information can be found in the Saskatchewan Learning document: *Aboriginal Elders and Community Workers in Schools*.

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Overview

Many cultures around the world, including the First Nations and Métis cultures of Canada, use stories as teaching tools. MacLean and Wason-Ellam (2006) state that storytelling indigenizes the curriculum, and is an empowering link to a sense of identity and the traditional knowledge of Indigenous people.

This lesson has story as its central point. Although the lesson is based on one specific story, teachers are encouraged to look for books in their own libraries with similar themes. The picture book is the story of wolves that are removed from their own habitat, and the effect this has on biodiversity and population dynamics.

This lesson incorporates objectives from the unit entitled Life Science: Sustainability of Ecosystems (SE) in the *Science 10 Curriculum Guide*.

Foundational Objectives

SE2 Examine biodiversity within local ecosystems.

SE3 Analyze population dynamics within an ecosystem.

Source: This and other objectives are found in the following document:
Saskatchewan Learning. (2005). *Science 10 curriculum guide*.
Regina: Saskatchewan Learning.

Timeframe

1-2 hours.

Resources

Gibb, T., et al. (2002). *Science 10: Concepts and connections*. Toronto: Nelson Thomson Learning.

Godkin, C. (1993). *Wolf Island*. Markham, ON: Fitzhenry & Whiteside.

Grace, E. et al. (2000). *Sciencepower 10: Science, technology, society, environment*. Toronto: McGraw-Hill Ryerson.

MacLean, M., & Wason-Ellam, L. (2006). *When Aboriginal and Métis teachers use storytelling as an instructional practice: A grant report to the Aboriginal Education Research Network*. Regina, SK: Saskatchewan Learning.

These titles and others are available for borrowing from the Stewart Resources Centre of the Saskatchewan Teachers' Federation.

Sustainability of Ecosystems

Foundational Objectives

- SE2** Examine biodiversity within local ecosystems.
SE3 Analyze population dynamics within an ecosystem.

Key Understandings

- Populations fluctuate dramatically in size.
- There are many natural factors that cause populations to change.
- Human actions can influence populations in indirect ways.

Essential Questions

1. What natural factors keep populations of organisms from growing forever?
2. What are predator/prey relationships and how do they impact one another?

Learning Objectives (LO)

Students will be able to:

- SE2** LO4 Explain how the biodiversity of an ecosystem contributes to its sustainability.
- SE2** LO11 Examine the factors that result in species becoming at-risk in Saskatchewan, the Prairies, and Canada.
- SE3** LO1 Explain various ways in which natural populations maintain equilibrium and relate this equilibrium to the resource limits of an ecosystem.

Assessment Evidence

- Answers from handout.
- Question pages (included).
- *Sciencepower 10*, Blackline master 1-1: You and Food Chains.
- *Sciencepower 10*, Blackline master 1-17: Population Terms.

Notes to the Teacher

This lesson uses story to capture students' interest and to bring the key concepts and terms of this section to life.

It can be difficult for students to distinguish between certain new terms when they are first introduced to them (for example - intraspecific and interspecific competition). When students hear the story of the wolves and other organisms on Wolf Island, they have

something real to which they can apply these new terms. As they use the terms in the assignment, they begin to understand them and make them a part of their own language.

When students are asked to recall information and/or give examples of certain terms on a quiz or test, it is much easier for them to talk about what happened on Wolf Island, rather than trying to memorize definitions from a textbook or dictionary.

Lesson Plan

1. Introduce the Essential Questions through class discussion.
2. Review and/or define key concepts and terms (*Science 10 Curriculum Guide*, pp. 32-33, pp. 35-36).
3. Introduce key concepts using the note page provided. Also see Unit Overview for other sources of background information.
 - Student/teacher copy included - Population Concepts
4. Make notes or a handout for students focusing on feeding levels and populations, or ask students to read or find answers to questions based on the material in:
 - *Sciencepower 10* - 1.2 Feeding Levels, pp. 8-17
 - *Sciencepower 10* - 1.3 Populations, pp. 18-24
 - *Nelson Science 10* - 1.4 What is the Value of Wolves?, pp. 20-21
5. Read the book *Wolf Island* by Celia Godkin to/with students. Have the book available for students to look through, to read again, and to find answers in it for the rest of this class and the following class.
6. Hand out the question booklet and read over the questions together while discussing possible answers. Tell the students to use the key terms and concepts sheet they have already completed. Questions 1-5 will require a review of the key terms from the Sustainability of Ecosystems learning objectives in the *Science 10 Curriculum Guide* (SE2).
 - Student copy included - Wolf Island Questions & Activities
 - Teacher copy included - Suggested Answers
7. Ask students to complete the following questions and activities:
 - Journal entry: *Sciencepower 10* - Blackline master 1-1: You and Food Chains
 - *Sciencepower 10* - Blackline master 1-17: Population Terms



Population Concepts

Key Concepts (Overhead notes)

1. A population **changes** with time according to:
 - a. Natality (birth rate)
 - b. Mortality (death rate)
 - c. Immigration (moving in)
 - d. Emigration (moving out)
2. Extremely fast growth of a population is called a **population explosion**. It may be caused by:
 - a. Introduced species (a new species is introduced into an ecosystem)
 - b. A plentiful food supply
 - c. A lack of predators
 - d. Abundant space available
3. Population **extinction** occurs when a greater number of species leave a population than enter it. If mortality, for whatever reason, is higher than natality, low population numbers can lead to inappropriate mating practices, during which harmful gene combinations may occur, causing genetic weakness and further decline in population.
4. Factors that determine **carrying capacity** are:
 - a. **Materials and energy** - energy from the sun, water, carbon, oxygen, and other essential nutrients.
 - b. **Food chains** - food supply, predator/prey relationships, plant populations, etc.
 - c. **Competition** - demand for resources. There are two types of competition:
 - i. **INTRAspecific** competition - competition among members of the same species. Example - two elk fighting over a mate.
 - ii. **INTERspecific** competition - competition among members of different species. Example - wolves vs. coyotes for food supply.
 - d. **Density** - depends on the size of the environment, way of life (needs), and population numbers. Also, a species can have different needs for space.
5. **Population density** means how many individuals can live in an area at one time. Population density can be divided into two different factors:
 - a. Density-**DEPENDENT** factors
 - b. Density-**INDEPENDENT** factors



Population Terms



NAME _____

Key Terms

Please write a clear definition for each of the following terms:

1. Population:

2. Community:

3. Carrying capacity:

4. Natality:

5. Mortality:

6. Immigration:

7. Emigration:

8. Closed system:

9. Limiting factors:

10. Density-dependent factors:

11. Density-independent factors:

Population Terms



Key Terms (Possible Definitions)

1. **Population** - All the members of a species living in the same habitat at a particular time.
2. **Community** - All of the organisms in an ecosystem.
3. **Carrying capacity** - The maximum number of individuals of a species that an ecosystem can support.
4. **Natality** - The birth rate in a population.
5. **Mortality** - The death rate in a population.
6. **Immigration** - The movement of members into a population.
7. **Emigration** - The movement of members out of a population.
8. **Closed system** - A system in which substances do not enter or leave.
9. **Limiting factors** - Factors that regulate populations using multiple criteria; intrinsic or extrinsic, biotic or abiotic, density-dependent or density-independent.
10. **Density-dependent factors** - Variables that affect a population based on the degree of crowding within the population. Example - disease due to overcrowding (parasites), food supply (starvation), intraspecific competition (aggression due to overcrowding), etc.
11. **Density-independent factors** - Variables that affect a population that are not based on population numbers. These are things that happen no matter how many individuals there are in a population. Example - floods, temperature extremes, forest fires, human interference (hunting, fishing, clear cutting, pollution of air, water, soil), etc.



Wolf Island Questions & Activities

NAME _____

After you have read or listened to the story *Wolf Island* by Celia Godkin, please complete the following questions and activities:

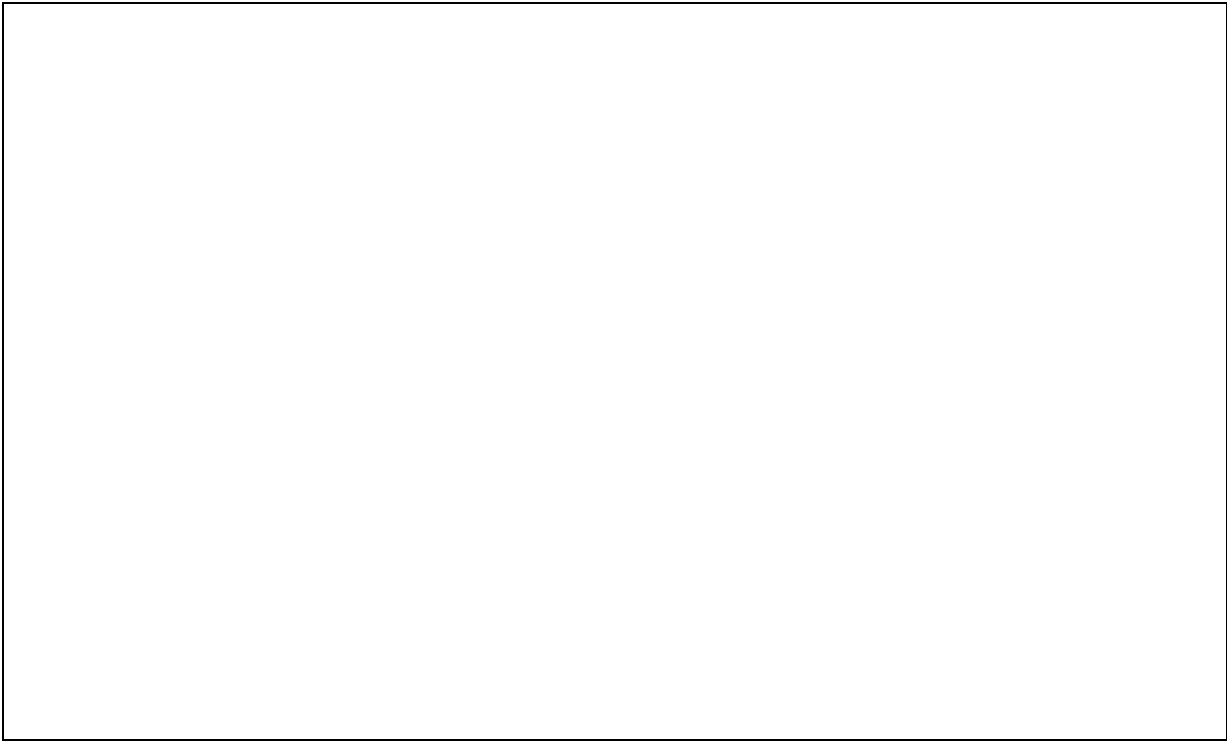
1. List two producers that live on Wolf Island.

2. List four consumers that are herbivores that live on Wolf Island.

3. List three consumers that are either omnivores or carnivores that live on the island.

4. Draw and label two food chains to show a linear relationship of at least three of the organisms above in each food chain. Be sure to show arrows to connect organisms.

5. Draw and label a food web, showing how the producers and consumers on Wolf Island live in balance with one another. Use arrows to connect the pictures and/or words.



6. Give an example of emigration in the story. Explain what happened.

7. Describe the population explosion on the island. Which species were involved in the explosion? What were the factors that caused the explosion?

8. A number of population decreases took place on the island. List which species were affected and the reasons for their loss in numbers.

9. Complete the table for each factor of the island's carrying capacity.

Factors	With the Wolves	Without the Wolves
Materials and energy		
Food Chains		
Competition		
Density		

10. Give an example of intraspecific competition on the island.

11. Give an example of interspecific competition on the island.

12. Make a list of density-*dependent* factors affecting the organisms on the island.

13. Make a list of density-*independent* factors affecting the organisms on the island.

14. Give an example of immigration in the story. Explain what happened.

15. Is Wolf Island a closed system? By your definition, would you consider Earth to be a closed system? Explain why or why not.

16. What do you think will happen in a few years following the return of the wolves to the island? Make a prediction using the scientific language you've learned.

Wolf Island Questions & Activities

(Suggested Answers)

(Total - 50 marks)



1. List two producers that live on Wolf Island. (2 marks)

Grass Trees

2. List four consumers that are herbivores that live on Wolf Island. (4 marks)

Mice Rabbits Squirrels Deer Some types of birds

3. List three consumers that are either omnivores or carnivores that live on the island. (3 marks)

Foxes Wolves Owls

4. Draw and label two food chains to show a linear relationship of at least three of the organisms above in each food chain. Be sure to show arrows to connect organisms. (2 marks – 1 for each food chain)

Student answers may vary.

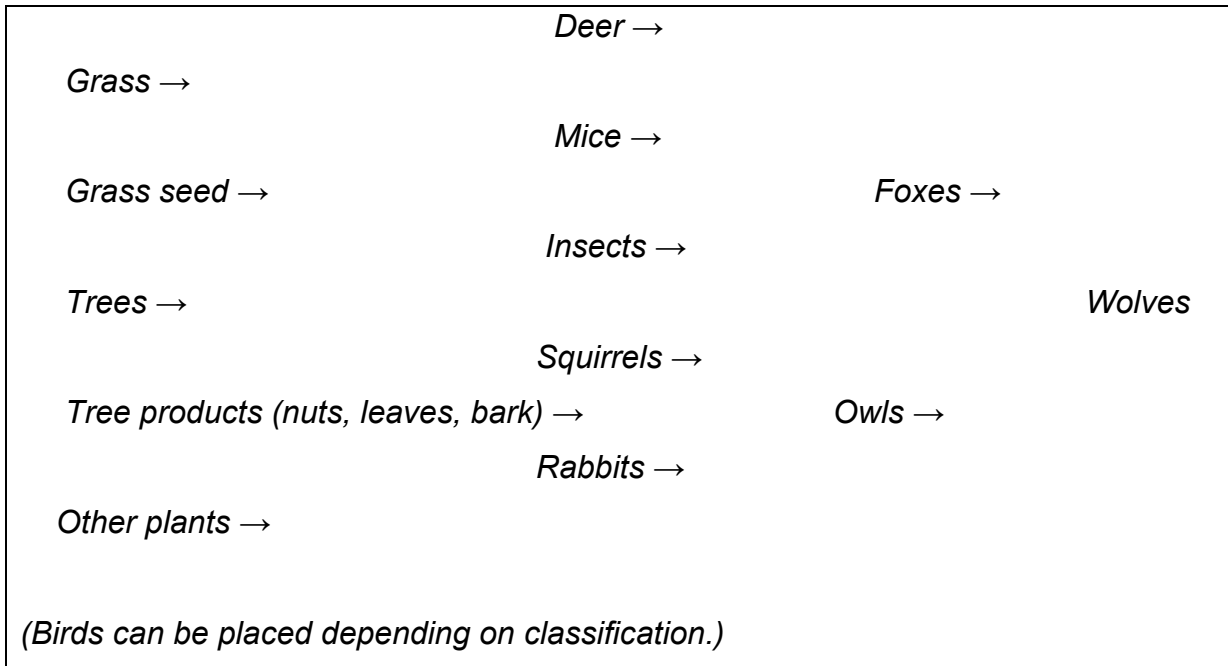
grass → rabbit → fox

grass → deer → wolf

Tree (nuts) → squirrel → owl

Many other combinations will be correct.

5. Draw and label a food web, showing how the producers and consumers on Wolf Island live in balance with one another. Use arrows to connect the pictures and/or words. (5 marks)



6. Give an example of emigration in the story. Explain what happened. (2 marks)

The wolves emigrated off the island by mistake, on a raft. This left the island unbalanced because there weren't any top predators (top carnivores) in the food chain. Also, owls and other birds could have emigrated because there wasn't enough food on the island and they had the option of flying to the mainland.

7. Describe the population explosion on the island. Which species were involved in the explosion? What were the factors that caused the explosion? (3 marks)

The deer population had an explosion because of a lack of predators and a plentiful food supply. Abundant space could also be a factor in the population explosion.

8. A number of population decreases took place on the island. List which species were affected and the reasons for their loss in numbers. (3 marks)

Many plant populations had a decrease because of the deer population explosion. As a result, the mice, rabbits, and any other herbivores on the island (insects, birds, etc.) experienced a decrease in population. This, in turn, affected the fox and owl populations because they had less prey with the decrease in mice and rabbits.

9. Complete the table for each factor of the island's carrying capacity. (8 marks)

Factors	With the Wolves	Without the Wolves
Materials and energy	<i>Energy from the sun, water, and nutrients are all balanced.</i>	<i>Materials and energy are not affected by the wolves emigration.</i>
Food Chains	<i>Producers, herbivores, omnivores, insectivores and carnivores are balanced in the food chain.</i>	<i>Producers → overeaten, not enough Herbivores → too many deer, others starving Carnivores → very hungry, not enough prey</i>
Competition	<i>Balanced</i>	<i>Too much competition for food among herbivores and omnivores. Lower level carnivores (foxes and owls) competing as well.</i>
Density	<i>Balanced</i>	<i>Not enough space for all the deer. Population density exceeds carrying capacity of the island.</i>

10. Give an example of intraspecific competition on the island. (1 mark)

An example of intraspecific competition would be deer vs. other deer for food supply and mates. Others may be used as examples fighting over food – mice vs. mice, rabbit vs. rabbit, fox vs. fox, etc.

11. Give an example of interspecific competition on the island. (1 mark)

An example of interspecific competition would be deer vs. any other herbivore for food supply, or foxes vs. owls for food supply.

12. Make a list of density-dependent factors affecting the organisms on the island. (3 marks)

All of the density dependent factors relate to the deer population, since they are the only species that had an overpopulation:

- *Lack of food (starvation)*
- *Disease*
- *Increased intraspecific and interspecific competition*

13. Make a list of density-independent factors affecting the organisms on the island. (3 marks)

The density-independent factors were:

- Lack of predators
- Mild winter weather
- Indirect human interference – the raft

14. Give an example of immigration in the story. Explain what happened. (2 marks)

The wolves immigrated from the mainland back to the island across the ice. They killed the sick deer and restored balance to the food chain.

15. Is Wolf Island a closed system? By your definition, would you consider Earth to be a closed system? Explain why or why not. (4 marks)

I would consider the island to be a partially-closed system because the wolves were able to emigrate and immigrate, as were the birds. In a truly closed system, nothing can leave or come in. This is the case for our earth. Our earth is a closed system because we have nowhere else to go, and nothing can come in.

16. What do you think will happen a few years following the return of the wolves to the island? Make a prediction using the scientific language you've learned. (4 marks)

Student answers may vary. The students should use the key terms to describe the conditions on the island in the future.



Bibliography

Gibb, T., et al. (2002). *Science 10: Concepts and connections*. Toronto: Nelson Thomson Learning.

Godkin, C. (1993). *Wolf Island*. Markham, ON: Fitzhenry & Whiteside.

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APPENDIX A

Elders in the Classroom

by
Anna-Leah King

It is the Elders' responsibility to guard sacred knowledge and to maintain the ceremonial oral tradition of knowledge transmission. In Saskatchewan, the territory is home to four First Nations, namely Cree, Saulteaux, Dene, and Ojibwa - Dakota/Nakoda/Lakota.

Source: Office of the Treaty Commissioner. (2002). *Teaching treaties in the classroom: Participants manual*. Saskatoon, SK: Office of the Treaty Commissioner.

All of these First Nations have a home here and it is entirely appropriate to represent any or all of these First Nations when approaching curriculum content. The Elders bring with them traditional knowledge and perspective passed down from generation to generation through the oral tradition. The reference to Elders' wisdom has lately been termed "Indigenous knowledge" or "traditional knowledge." Their traditional knowledge and wisdom will give insight to teachers willing to reshape curriculum and validating First Nations content and perspective.

Inviting the Elders

Protocol

The Elders would expect to be approached in the traditional way, respecting traditional protocol. They are given a small offering of tobacco in exchange for their commitment to invest their time and energy into the work at hand. They can be asked to lead the gatherings with prayer and ceremony. First Nations gatherings always begin with prayer and ceremony. It is entirely appropriate to ask this of them. It may not be what you are familiar with, but you will soon realize the benefits of respecting First Nations protocol and ceremonial practice. The Elders may want to begin with a smudge on the first gathering and offer prayer for the task at hand and the team that has been brought together. The Elders are well aware that any given group put together is there to learn from one another and so blessings towards this endeavour are prayed for. Sometimes, depending on the size of the project, a pipe ceremony may be requested. Each Elder may have a slightly different approach to opening and closing ceremony. Some may speak for a while. Others will ask you to share so they can become more familiar with everyone. Simply inviting them with an offering of tobacco and asking that they open and close the gatherings is enough. The Elder will take it from there.

Elder Expectation

When you invite Elders, it is important that you are clear on what you expect from them. If you are asking them to contribute with their knowledge, wisdom, and guidance, then say so. They may not all be familiar with education and what teachers and curriculum writers are trying to do, so explaining what curricula is and what is needed of them is essential to a good working relationship. You want them to contribute First Nations and Métis content and perspective. The Elders need to feel confident that they will be of assistance. Let them know that you see their role as wisdom keepers and they need to draw upon their personal experience, cultural knowledge, and teachings to contribute to the process. The Elders will share what is acceptable and give caution for what they view as sacred knowledge that is only to be shared in the context of ceremony.

Elders need time to think before they answer. Do not be impatient and feel they are not answering soon enough, as they will answer your questions in time. Some Elders are reflective, philosophical thinkers. They will review holistically what you have asked of them. A concept that you think is simple and straightforward has many different dimensions to a First Nations speaker, and they must put the concept into the context of the whole and analyze the dimension of its interrelatedness. Sometimes they translate what you are saying to themselves in their language. They think things out in their mother tongue first and then find the words of closest approximation in English. Not all words and concepts are readily translatable. That is why letting the Elder know what is expected of them beforehand is important because it gives them time to think it over and to find some area of common ground.

Elder Care

Elders do not expect anything but it would be nice to assign one person to see to their needs. Offer them a comfortable seat and debrief them on the expectations for the gathering. Introduce them to everyone and generally make them feel welcome. See to it that they have water, juice, coffee, or tea. It is good to have a snack for them at coffee break. Invite them to pray over the food before you eat. Allow them to be first in line for lunch or let them know you will serve them. This is an example of First Nations protocol. These are small things, but kind gestures go a long way with Elders. They appreciate when younger people make efforts to lighten their load. These gestures make the Elder feel welcome and cared for in a respectful way.

Gifts

It is appropriate to have a small gift for the Elders. If they are paid for their time, this would be considered the gift. Some give a small gift in addition to the honorarium, such as a basket of teas or jams.

- Further information can be found in the document: *Aboriginal Elders and Community Workers in the Classroom*, available from the First Nations and Métis Branch of the Ministry of Education.