

Lesson 6 | Evaluate

Nourishing the Planet in the 21st Century

At a Glance

Overview

In this concluding lesson, students continue in their roles as agricultural experts. First, they discuss what challenges must be met in order to feed the world's population in 2050. Students then analyze a list of 10 recommendations about farming and select the three that they feel are most important. A class discussion results in choosing the top five recommendations. As a homework assignment, students explain why their choices were better than the three recommendations that received the fewest votes.



Major Concepts

- The world's growing population demands that more food be produced in the future.
- Unless crop yields continue to improve, a greater portion of the world's land will have to be devoted to farming.
- A variety of farming practices can contribute to increases in food productivity.
- Meeting the challenge of nourishing the planet in the 21st century is a concern for all nations.

Objectives

After completing this lesson, students will be able to

- appreciate how soil properties contribute to plant health,
- recognize that nutrient deficiencies limit crop productivity,
- understand the role of plant nutrients in growing plants and in restoring nutrient balance to agricultural soils,



- relate crop productivity to the need for more farmland, and
- describe challenges associated with feeding the world's growing population.

Teacher Background

Consult all sections in *Teacher Background*.

In Advance

Photocopies

Activity 1 Master 6.1, *Memo from the Secretary General* (Prepare an overhead transparency.)
 Master 6.2, *Review of Lessons* (Make 1 copy per student and prepare an overhead transparency.)
 Master 6.3, *Recommendations for Nourishing the Planet* (Make 1 copy per group of 3 students and prepare an overhead transparency.)
 Master 6.4, *Recommendations Worksheet* (Make 1 copy per student.)

Materials

Activity 1 No materials except photocopies and transparencies

Preparation

No preparations are needed except for making photocopies and transparencies.

Procedure

Activity 1: Nourishing the Planet in the 21st Century

Teacher note

This lesson involves a scenario where students play the roles of agricultural experts helping make recommendations about farming. They are given a list of 10 recommendations and are asked to decide which are the most important. These recommendations do not address many issues that are important to feeding our growing population. Topics such as water management, genetically modified food, and no-till farming are not mentioned. Remember that the intention of this lesson is not to engage in a thorough examination of all aspects of farming but rather to provide a vehicle for students to reflect on and use what they have learned throughout the course of this module. The discussions and writing tasks in this lesson provide you with an opportunity to assess how well the students have mastered the concepts addressed during the previous five lessons.

- 1. Introduce the lesson by asking the class to think about the challenges associated with feeding an extra 2 billion or 3 billion people by the year 2050.**

Although the year 2050 will seem like forever to students, you may point out that most of them will be living during this time and will see firsthand how well, or not, societies have met these challenges.

Tip from the field test

Have students calculate how old they will be in the year 2050. This helps reinforce the idea that they can expect to be around to see how well the challenge of feeding the planet was met.



2. **Explain that in this lesson, they will continue in their roles as agricultural experts. Display a transparency of Master 6.1, *Memo from the Secretary General*. Ask a student volunteer to read the memo aloud.**
3. **Display a transparency of Master 6.2, *Review of Lessons* and pass out a copy of the master to each student. Explain that if they are to function as agricultural experts, then they should take a moment to review what they have learned.**

Expectations:

Students will:

- formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research.
- analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty.
- draw conclusions based on inquiry results and research findings, and justify their conclusions.



4. **Ask students to think back to the first lesson and explain what they learned about plants and their essential elements.**

If necessary, remind the students what activities made up that lesson. Summarize their responses on the transparency of Master 6.2, *Review of Lessons* and instruct students to take notes on their copies of the master. If not brought up by a student, guide the discussion to bring out the following:

- Plants require 17 essential nutrients to complete their life cycle.
- Plants and humans require similar sets of essential nutrients.
- Plants obtain their essential nutrients from air, water, and soil.

5. **Continue going through Lessons 2 through 5, reminding the students of which activities were performed and summarizing their responses on the transparency.**

If not brought up by a student, guide the discussion to bring out the following:

Lesson 2

- Soils vary in their compositions.
- Soils are a “bank” of nutrients.
- Soils contain both organic and inorganic materials.
- Soils contain differing amounts of air space.
- Soils differ in their abilities to hold and transmit water.



Lesson 3

- Plants remove water and nutrients from the soil through the plant's root system.
- Some nutrients move into root cells from the soil by diffusion and others by an energy-requiring process (active transport).
- The plant vascular system has similarities to the human circulatory system.
- Plants transport water from the roots to the rest of the plant using the xylem.
- Plants transport food from the leaves to the rest of the plant using the phloem.

Lesson 4

- Plants, like people, require essential elements to be present in certain quantities in order to be healthy.
- Plants extract nutrients from the soil; people remove nutrients as crops.
- Plants with nutrient deficiencies show specific symptoms.
- Fertilizer is food for plants.
- The soil is a "nutrient bank" that can hold a limited amount of nutrients. Commercial and organic fertilizers put more "money" in the bank by restoring nutrient balance to agricultural soils.

Lesson 5

- Only a small portion of Earth's surface is used to grow food.
- The world's population is growing at a steady rate.
- Unless food productivity increases, more land will have to be farmed.
- Fertilizers help increase food productivity.
- Fertilizers can be commercial or organic.
- Excessive amounts of nutrients can pollute water, soil, and air.

6. Divide the class into groups of 3 students. Pass out to each group a copy of Master 6.3, *Recommendations for Nourishing the Planet* and a copy of Master 6.4, *Recommendations Worksheet*.

7. Instruct the groups to read the list of 10 recommendations on Master 6.3, *Recommendations for Nourishing the Planet*, discuss them within their groups, and decide which are the three recommendations most important to helping farmers meet the challenge of feeding the world's growing population.

Students should write their selections in the appropriate spaces on Master 6.4, *Recommendations Worksheet*. Beneath each selected recommendation is a space where the student should explain why they believe that their choice is among the most important recommendations that should be made about farming in the future. Allow groups about 20 minutes to complete their tasks.

Teacher note

You will notice that all of the recommendations are reasonable. Each one is important for food production or environmental protection. The rationale here is for students to consider how farmers can increase food production. Encourage them to refer to their notes on Master 6.2, *Review of Lessons*, review what they have learned from the module, use their critical-thinking skills to review the choices, and select those that they feel are most important for farmers to implement.

8. After students have completed their worksheets, display a transparency of Master 6.3, *Recommendations for Nourishing the Planet*. Read the first recommendation aloud and ask how many groups included it as part of the top three recommendations. Next to the recommendation, write the number of groups that selected it.

Expectations:

Students will:

- propose possible solutions, on the basis of research, to a current practical environmental problem that is caused, directly or indirectly, by human activities.
- assess, on the basis of research, the impact of a factor related to human activity (e.g., *urban sprawl, introduction of invasive species, overhunting/overfishing*) that threatens the sustainability of a terrestrial or aquatic ecosystem.
- plan and conduct an investigation, involving both inquiry and research, into how a human activity affects soil composition or soil fertility (e.g., *changes to soil composition resulting from the use of different compostable materials, organic or inorganic fertilizers, or pesticides*), and, extrapolating from the data and information gathered, explain the impact of this activity on the sustainability of terrestrial ecosystems.
- analyse, on the basis of research, how a human activity threatens the sustainability of a terrestrial or aquatic ecosystem.
- analyse some of the risks and benefits of human intervention (e.g., *tree plantations; monoculture of live-stock or agricultural crops; overharvesting of wild plants for medicinal purposes; using pesticides to control pests; suppression of wild fires*) to the biodiversity of aquatic or terrestrial ecosystems.
- assess the positive and negative impact of human activities on the natural balance of plants (e.g., *crop rotation, the use of fertilizers and herbicides, the introduction of new species*).
- explain agricultural techniques and forestry practices that aim to maintain both biodiversity and long-term productivity.
- assess the environmental implications of food choices available in a variety of situations (e.g., *in the school cafeteria, a fast-food restaurant, a supermarket, a local farmers' market, an organic meat shop*), and propose ways to minimize the environmental impact of their food choices.



Expectations:

Students will:

- assess, on the basis of research, the effectiveness of some Canadian technologies and projects intended to nourish expanding populations (e.g., *the risks and benefits of growing genetically modified canola*).
- analyse, on the basis of research, some of the social, ethical, and legal implications of biotechnology (e.g., *the bioengineering of animal species, especially those intended for human consumption; the cultivation of transgenic crops; the patenting of life forms; cloning*).
- analyse ways in which societal needs or demands have influenced scientific endeavours related to the environment (e.g., *the development of drought- and pest-resistant crops to address the rising global need for food*).



- explain agricultural techniques and forestry practices that aim to maintain both biodiversity and long-term productivity (e.g., growing a variety of species, inter-planting crops, planting native and heritage varieties instead of hybrids or transgenic species, saving seeds, maintaining some older trees and snags for animal habitat).
- investigate human impact on ecosystems.
- compare the risks and benefits to society and the environment of applying scientific knowledge or introducing a technology.

9. Ask for volunteers to explain why they believe that recommendation is among the most important.

After the first student speaks, ask if anyone has additional reasons for choosing it. Allow students to provide all of their reasons before moving on to the next recommendation.

10. Continue this process until all 10 recommendations have been discussed.

Make sure you have tallied how many groups voted for each recommendation.

11. Remind the class that the secretary general asked them to submit a list of the top five recommendations. Examine the vote totals and decide which five should be sent to the secretary general.

If some recommendations have the same number of votes, discuss them further until a consensus is reached or break the tie by choosing a recommendation for which you would like an additional assessment opportunity.



Optional Homework Assignment 1

Ask students to write a letter to the secretary general that defends their recommendations.

Students should refer to what they have learned during the module in making their arguments. Students' arguments should demonstrate an awareness of

- essential plant nutrients,
- the importance of fertile agricultural soils (not necessarily other soils),
- the mechanisms by which plants obtain and transport nutrients,
- the effects of nutrient deficiencies,
- the role of plant nutrients in promoting crop growth,
- the impacts of nutrients on the environment, and
- the relationship between crop yields and land use.



Optional Homework Assignment 2

Ask students to research and write a short paper that describes a strategy for increasing world food production. The strategy should be one that was not discussed during the lesson.

If students are having trouble focusing their research, suggest a topic such as genetically modified foods.

M = Involves copying a master

T = Involves making a transparency

Lesson 6 Organizer		
Activity 1: <i>Nourishing the Planet in the 21st Century</i> What the Teacher Does		Procedure Reference
Ask the students to consider the challenges associated with feeding an extra 2 billion or 3 billion people by the year 2050.		Page 134 Step 1
Explain that they will continue in their roles as agricultural experts. <ul style="list-style-type: none"> ■ Display a transparency of Master 6.1, <i>Memo from the Secretary General</i>. ■ Ask a volunteer to read it aloud. 	Page 135 Steps 2	T
Display a transparency of Master 6.2, <i>Review of Lessons</i> and give each student a copy of the master. <ul style="list-style-type: none"> ■ Explain that they will review what they have learned in the previous lessons. 	Page 135 Step 3	T M
Ask students to think back to Lesson 1 and describe what they learned about plants and their essential elements. <ul style="list-style-type: none"> ■ Summarize their responses on the transparency of Master 6.2, <i>Review of Lessons</i>. 	Page 135 Step 4	T
Discuss Lessons 2 through 5. <ul style="list-style-type: none"> ■ Remind the students which activities were part of each lesson. ■ Summarize their responses on the transparency of Master 6.2, <i>Review of Lessons</i>. 	Page 135-136 Step 5	T
Divide the class into groups of 3 students. <ul style="list-style-type: none"> ■ Give each group a copy of Master 6.3, <i>Recommendations for Nourishing the Planet</i>. ■ Give each group a copy of Master 6.4, <i>Recommendations Worksheet</i>. 	Page 136 Step 6	M
Instruct the groups to read the recommendations on Master 6.3, <i>Recommendations for Nourishing the Planet</i> , discuss them, and decide which three are most important. <ul style="list-style-type: none"> ■ Students should write their selections and reasons on Master 6.4, <i>Recommendations Worksheet</i>. 	Page 136 Step 7	M
Display a transparency of Master 6.3, <i>Recommendations for Nourishing the Planet</i> . <ul style="list-style-type: none"> ■ Read the first recommendation and ask how many groups selected it. ■ Write down the number of groups that selected it. 	Page 137 Step 8	T
Ask for volunteers to explain why they feel that recommendation is important.		Page 138 Step 9
Continue with this process until all 10 recommendations have been discussed.		Page 138 Step 10
Remind students that they must submit a list of their top five recommendations. <ul style="list-style-type: none"> ■ Examine the vote totals and compile a list of the top five recommendations. 		Page 138 Step 11





Earth
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Bank

MEMO

To: Chairperson of the Earth Food Bank Executive Committee on Increasing Our World's Food Supply

From: Secretary General of the Earth Food Bank

About: Recommendations about Farming

Regarding our initiative *Nourishing the Planet in the 21st Century*, I have received the preliminary report from the Committee on Increasing Crop Yields. I am preparing an executive summary that will be released worldwide to the press. This press release needs to include the recommendations that the committee feels are most important to help farmers feed our growing population. Although the final committee report will discuss these recommendations in detail, the press release needs to be short and to the point.

I have included with this memo a list of 10 recommendations from the preliminary report. I would like the executive committee to review these recommendations and select what it considers to be the top five most-important recommendations about farming. I will include these recommendations in my executive summary.

Thank you for your hard work and dedication to this important project.



Master 6.2, Review of Lessons

Name _____

Date _____

1. Essential elements

2. Properties of soils

3. Moving nutrients through plants



4. Nutrient deficiencies

5. Land use





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Name _____
Date _____

1. Farmers should use soils that allow plants to develop a healthy root system.
2. Whenever feasible, farmers should fully utilize all available organic fertilizers where available and economically beneficial.
3. Farmers should only grow crops in soils that have enough air space to allow water and oxygen gas to seep in and support plant growth.
4. Wherever needed and feasible farmers can use commercial fertilizers economically to supplement crop nutrient needs.
5. Farmers should use management practices that minimize nutrient losses to air and water.
6. Farmers should learn to diagnose plant nutrient deficiencies and use supplemental plant nutrient sources to correct deficiencies.
7. Farmers should use scientific methods that maintain the long-term fertility of the soil.
8. Land without fertile soil should not be used for farming, as it is more vulnerable to degradation from wind and water erosion because of the inadequate crop cover grown.
9. Farmers should use the proper amounts of plant nutrients that supply essential nutrients that are missing from their soil.
10. Farmers should use the least amount of land necessary to feed the world's population, and to support society's other land use objectives.



Master 6.4, Recommendations Worksheet

Name _____
Date _____

Procedure

- Step 1.** Read Master 6.3, *Recommendations for Nourishing the Planet*.
- Step 2.** Select the three recommendations that you feel are most important in order for farmers to meet the challenge of nourishing the world's population in the year 2050.
- Step 3.** Discuss your selections with others in your group.
- Step 4.** Write down your selections in the following spaces. Include an explanation of why each of your choices is among the most important.

First Recommendation
Explanation

Second Recommendation
Explanation

Third Recommendation
Explanation

