

4R NUTRIENT STEWARDSHIP: LESSON ONE

This course introduces students to agricultural sustainability through the implementation of 4R Nutrient Stewardship (Right Source @ Right Rate, Right Time, and Right Place®).

*INTRODUCING 4R NUTRIENT
STEWARDSHIP ACROSS CANADA*

NUTRIENTS
FOR LIFE



NUTRIMENTS
POUR LA VIE

Overview

This course introduces students to agricultural sustainability through the implementation of 4R Nutrient Stewardship (Right Source @ Right Rate, Right Time, and Right Place®). Discussions will surround how the 4R framework helps farmers maximize yields and minimize environmental impacts. This introduction to 4R Nutrient Stewardship also helps students explore modern agriculture and why sustainable practices are crucial to feeding a growing global population.

Key concepts

- Our growing world population puts increasing pressures on our current food system and agriculture;
- How to define and understand sustainable agriculture, including 4R Nutrient Stewardship;
- Understand the three pillars of sustainability – economic, social, and environmental, and;
- Learn how to apply the concept and application of the 4R framework for sustainability in agriculture.

Objectives

After completing this lesson, students will be able to

- **Define** 4R Nutrient Stewardship and its importance;
- **Identify** and distinguish between the 4Rs of Nutrient Stewardship (Right Source @ Right Rate, Right Time, and Right Place®);
- **Describe** common examples of applications of 4R Nutrient Stewardship;
- **Identify** potential sources of nutrient pollution (locally), and;
- **Recognize** the benefits of sustainable agricultural practices.

Activities

Activity 1: Introducing 4R Nutrient Stewardship.

Activity 2: Beat the Bell – a 4R Nutrient Stewardship Bell Ringer.



Activity one: Introducing 4R Nutrient Stewardship

Overview

Activity one introduces students to the concept of sustainable agriculture, specifically the principles of 4R Nutrient Stewardship. This exercise will teach students to easily identify and understand 4R Nutrient Stewardship and its applications to our current agricultural needs. Students can complete this individually or in small groups.

Materials

- Roots for Growth Video;
- Audio and video equipment;
- Teacher PowerPoint presentation - 4R Basics.

**Please note: all materials are available on our website at nutrientsforlife.ca*

Pre-activity discussion

Let's Discuss - Feeding Crops to Feed the Future

- How do you define agriculture and what does it mean to you? Imagine what comes to mind when you think of agriculture?
- Do you see an old man wearing overalls plowing the dirt with an old tractor? Or maybe you see a scientist using a satellite-based computer program to examine current climate changes, crop yields, and fertilizer applications?
- Maybe you see an agronomist testing the soil in agricultural fields developing a new plant that can absorb five (5) times its own weight in water?
- The big idea here is agriculture is ever changing. Agriculture of today is modern, fast paced, and competitive and yet requires one key element, can you guess it? Sustainability!
- Is agriculture growing towards sustainability? Let's delve into that in a bit more detail below.



Introduce the key concept: 4R Nutrient Stewardship Principles

The 4R Nutrient Stewardship principles are the same globally, but how they are used locally varies depending on field and site-specific characteristics such as soil, cropping systems, management techniques and climate, etc. The scientific principles of the 4R framework include:



The 4Rs work to increase production/profitability for farmers while ensuring the future of the agricultural industry



Right Source – Ensure a balanced supply of essential nutrients, considering both naturally available sources and the characteristics of specific products, in plant available forms.

Right Rate – Assess and make decisions based on soil nutrient supply and plant demand.

Right Time – Assess and make decisions based on the dynamics of crop uptake, soil supply, nutrient loss risks, and field operation logistics.

Right Place – Address root-soil dynamics and nutrient movement, and manage spatial variability within the field to meet site-specific crop needs and limit potential losses from the field.

Video

Roots for Growth: Watch Roots for Growth 4R Nutrient Stewardship video as a class for a real life example to help understand how 4R Nutrient Stewardship fits into sustainability and agriculture.

Let's discuss

1. Concept review

Review the concept of 4R Nutrient Stewardship and its definitions

Start discussing with students what are the benefits of using 4R nutrient stewardship?

2. Brainstorm ideas

Continue the discussion by asking students to form small groups to brainstorm ideas about some of the main goals of 4R Nutrient Stewardship. Ask them to write examples in a diagram on the board under the three main headings: Social, Environmental, and Economic.

3. Activity follow-up

As a review ask students individually, or as a group, to answer the accompanying question sheet, followed by a group discussion.



Activity 1 Introducing 4R Nutrient Stewardship

Teacher Resource Background Information

Today's farmers live in a world where environmental concerns and increased food demand create challenges like never seen before. But we can meet those challenges with 4R Nutrient Stewardship.

Issue/concern: According to the United Nations, the global population will increase by more than two billion people in the next 40 years, and many reports have indicated that agricultural production needs to double by 2050. Industry experts agree increased production of food, fibre, and fuel will be achieved by intensified production and not by expanded arable land base. Genetic and biotech seed industries have predicted yield increases of three to four percent per year. However, to optimize the yields of advanced seeds, fertilizer inputs must be optimized to provide the greatest potential for success.

Benefits of using 4R Nutrient Stewardship

4R Nutrient Stewardship helps improve agricultural productivity:

- Optimizing nutrient management is simply good business in dealing with fluctuations in prices of fertilizers and other inputs, as well as in process of crops sold.
- Higher crop yields are well documented with better crop and soil management.
- Improved fertilizer efficiency increases the quantity produced per acre for each unit of nutrient applied, without sacrificing yield potential.

4R Nutrient Stewardship helps minimize impact to the environment:

- Adopting nutrient stewardship contributes to the preservation of natural ecosystems by growing more on less land.
- Retaining nutrients within a field's boundaries and in the crop's rooting zone greatly reduces the amount that is not utilized by plants and thereby escapes into the environment as pollution.



4R Nutrient Stewardship helps promote sustainability goals

Some commonly identified grower objectives that promote the sustainable nature of 4R nutrient stewardship include the following goals:

Economic goals

- Improve net farm income.
- Contribute to improved regional economic development.

Social goals

- Improve the quality of farm family housing, diet, and education.
- Improve productivity of farm labor by appropriate use of emerging technologies that increase efficiencies of field operations and reduce costs per unit of crop harvested.
- Improve access to sources of information to assist in farm management decision-making.

Environmental goals

- Maintain or reduce unwanted losses of nutrients to the environment:
- Reduce soil erosion of nutrient containing soil particles;
- Reduce volatile ammonia (NH_3) emissions;
- Reduce nitrification / de-nitrification losses of nitrous oxide (N_2O) and di-nitrogen (N_2).
- Reduce energy use per harvested unit of farm production.
- Improve recycling of crop nutrients from crop residues and livestock manures.

Reference: For more information please refer to the 4R Nutrient Stewardship pocket guide.





Name:

Date:

4R Nutrient Stewardship Instructions

Examine the video 4R nutrient stewardship roots for growth: Feeding the World video and answer the following questions.

Video: 4R Nutrient Stewardship Roots for Growth: Feeding the World

1. What do we need to do to achieve global food security?
2. How can we meet this challenge?
3. What is the role of fertilizer in crop use?
4. What is the definition of 4R Nutrient Stewardship?
5. Why is 4R Nutrient Stewardship important now and for the future?
6. Can you name each of the 4Rs and give an example?
7. What are the benefits of using 4R Nutrient Stewardship?



Activity 2: Beat the Bell for 4R Nutrient Stewardship

A 4R Bell Ringer Teacher Instructions

Preparation

Set up 4R stations for the bell ringer and be ready with 4R activity cards. Prepare photocopies for students to record answers.

Procedure

Activity 1: Beat the bell for 4R nutrient stewardship

Tips for learning

This activity uses hands on learning combined with group interaction to quickly identify differences each of the 4Rs. After completing the exercise, open a discussion with students regarding their rationale for choosing each specific 4R.

Explain to the class that these are everyday farm management examples that farmers and agronomists need to make in order to successfully adopt 4R nutrient stewardship. It is essential that the people involved within the farm management decisions understand very quickly and identify what actions are applicable under each of the 4Rs.

Expectations

Students will:

- **Gain** a solid understanding of the importance of sustainable agriculture and how it relates to food security and the pressures of increasing population growth and associated environmental concerns.
- **Assess** very quickly with real-life farm management examples to identify which 4R it is representative of. Quick identification helps to ensure all elements are working effectively given the 4R framework.



Materials

- Clock or stopwatch
- Bell, whistle, or noisemaker
- 10 potential stations with station cards attached (photocopy)
- Student Answer Sheet (photocopy)

Activity 1 Setup (prior to class) – Are you ready?

Print out station card questions for each of the ten stations. Pick locations around the classroom to represent each station and place the station card in place (could be taped on a surface along with a station number. Find a bell, noisemaker, or whistle and a stopwatch or clock. Photocopy student activity sheets for each group or for each student. You can keep a list of examples of each of the 4Rs at each station but its optional. You can also allow students to try to figure it out themselves for more advanced classes. Let's get started...

Activity 1 – Beat the Bell to 4R nutrient stewardship Teacher Instructions

- Time: approximately 20 min
- Students: small groups of 2-3 or to be completed individually

Activity Instructions

Read the 4R activity card at each station and accurately identify and record which 4R best characterizes the activity card example and your rationale for choosing each 4R. You have 60 seconds to answer each question. Then the bell rings. The sound signifies time is up and you need to move to the next 4R activity station. Please note that in some examples more than one 4R may apply.



Name/Group:

Date:

**Table 1-1: 4R Student Activity Sheet for Beat the Bell
4R Bell Ringer**

Station ID No.	4R Example (Source, Rate, Time, Place)	Rationale
1		
2		
3		
4		
5		



Name/Group:

Date:

**Table 1-1: 4R Student Activity Sheet for Beat the Bell
4R Bell Ringer**

Station ID No.	4R Example (Source, Rate, Time, Place)	Rationale
6		
7		
8		
9		
10		



4R NUTRIENT STEWARDSHIP: LESSON ONE

For more 4R Nutrient Stewardship resources
or information, please visit:

nutrientsforlife.ca