4.1 Modifying Environments to Increase Yields

Figure 4.1 We all need products made from plants.

Our population is growing every day. All these people need more plants to produce enough food and fibre to meet their needs. Scientists and growers have developed technologies that increase the **yield** of plants. Yield means the amount of useful plant part per plant.

*info*BIT

A Change for the Better

Some islands in the Pacific Ocean have soil that contains large amounts of salt. People on these islands grow their crops by **hydroponics**, which doesn't use soil at all!

Give it a **TRY**

ACTIVITY

MAKING CHANGES

Growers and scientists have developed many technologies to change the environment to suit the plants we want to produce. Each of these pictures shows a different way of modifying the environment.

Figure 4.2

Figure 4.3

Figure 4.4

Figure 4.5

In each of these situations, what environmental condition is being changed?

Problem Solving Activity

Growing Plants without Soil

Recognize a Need

You want to start a small company that supplies specialty vegetables to restaurants. You know that the kinds of plants you need won't grow well in the outside environment. So you have decided to try to build your own indoor hydroponic system. A hydroponic system is an artificial environment that doesn't use soil.

The Problem

Build a working prototype of a hydroponic system.

Criteria for Success

To be considered successful, your hydroponic system should meet the following criteria:

- It must be constructed from materials in the classroom and from your home.
- It must use a nutrient solution in the place of soil.
- It must provide a seedling with a controlled amount of light and nutrients.
- It must operate for at least one week.

Brainstorm Ideas

1. In a small group, work together to develop ideas. Sketch out the suggestions as you work, and review what each part in your system is supposed to do.
2. Develop a list of materials that could be used to create your hydroponic system. Here are some things to start you off:
   - clean gravel or marbles to support the roots
   - aquarium air pump to keep air around the roots
   - large plastic tub in which to place the nutrient solution
   - liquid or soluble plant food to supply nutrients
3. Pick the idea that you think is most likely to meet the criteria for a successful hydroponic system. Prepare a step-by-step plan of what you intend to do and a list of everything you will need.
4. Show your plan and your list to your teacher. Be prepared to explain how your system will work. When your teacher has approved your plan, you can start to build your prototype.

Build a Prototype

5. Put your prototype together, following the plan that your teacher approved. Do not put a plant in your system until you have finished building it and have checked for leaks or other problems.

Figure 4.6 A simple hydroponic system

Caution!
Water and electricity do not mix! Do not plug in any device close to water.

Test and Evaluate

6 Move your completed system to the area set aside by your teacher. Put a seedling into your system. Be careful not to damage its roots as you do this. Turn on your system.

7 Check your system at least once a day over the next week. Make changes to your system to correct any problems you encounter.

Communicate

8 Present your system to your classmates. Explain how your system was supposed to work. Give an honest evaluation of how well your system did what it was supposed to do, and whether it meets the criteria for success.

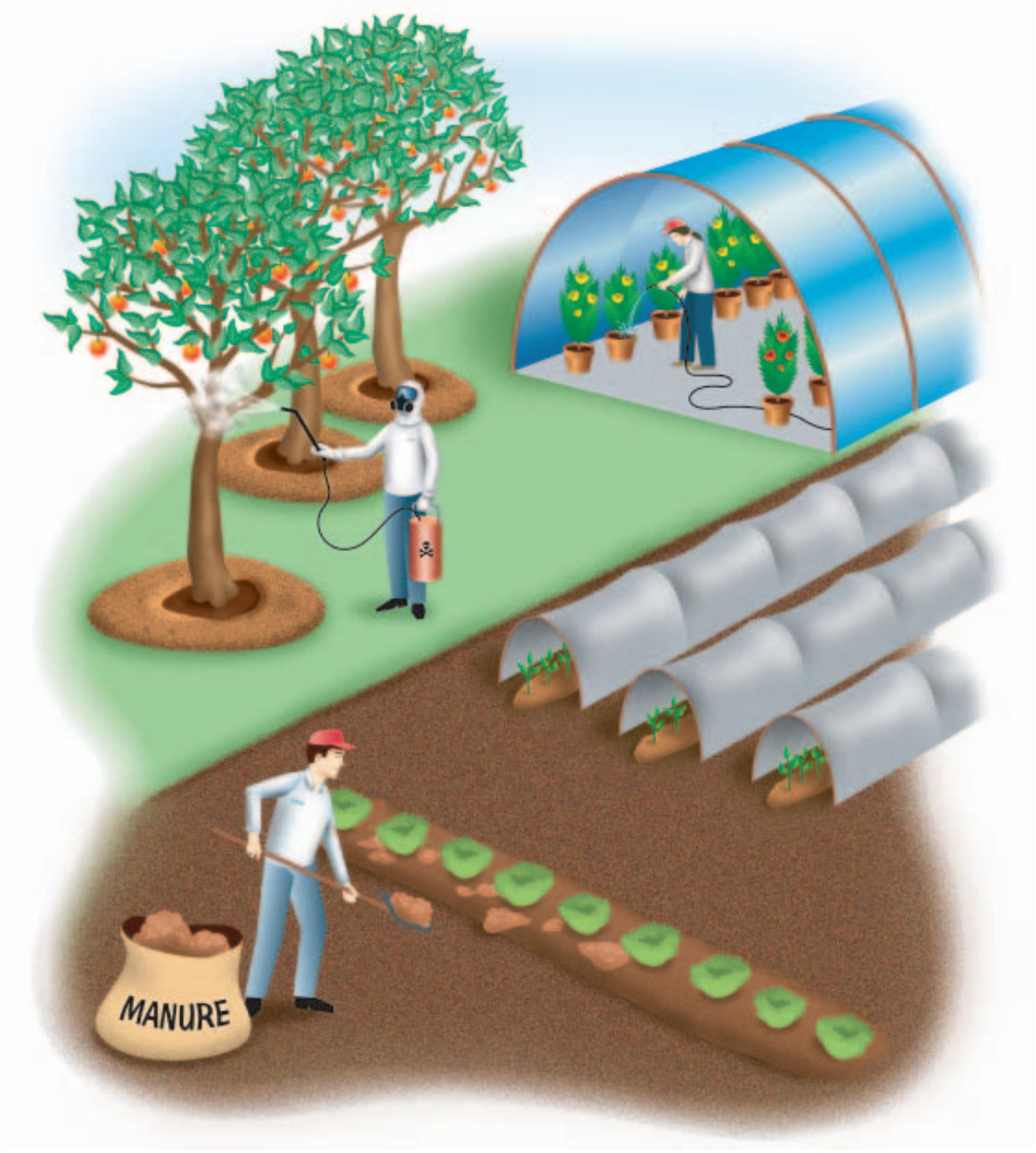
9 You might also want to share any changes you made to your system during the week. What would you do differently if you could build another prototype?

Extending

Your hydroponic system controls all the growing conditions for a plant. Design and carry out an experiment to test the effects of different nutrients on plant growth.

Technologies to Produce and Harvest Plants

To get the best yield possible, we have developed technologies that help provide the best growing conditions for plants. What kind of technologies can you find in this illustration?



Artificial Environments to Control Growing Conditions

Sometimes we produce plants in artificial environments, in which we control all the growing conditions. Greenhouses are one example of an artificial environment. Plants in a greenhouse always have the right temperature, light, and nutrients for their needs.

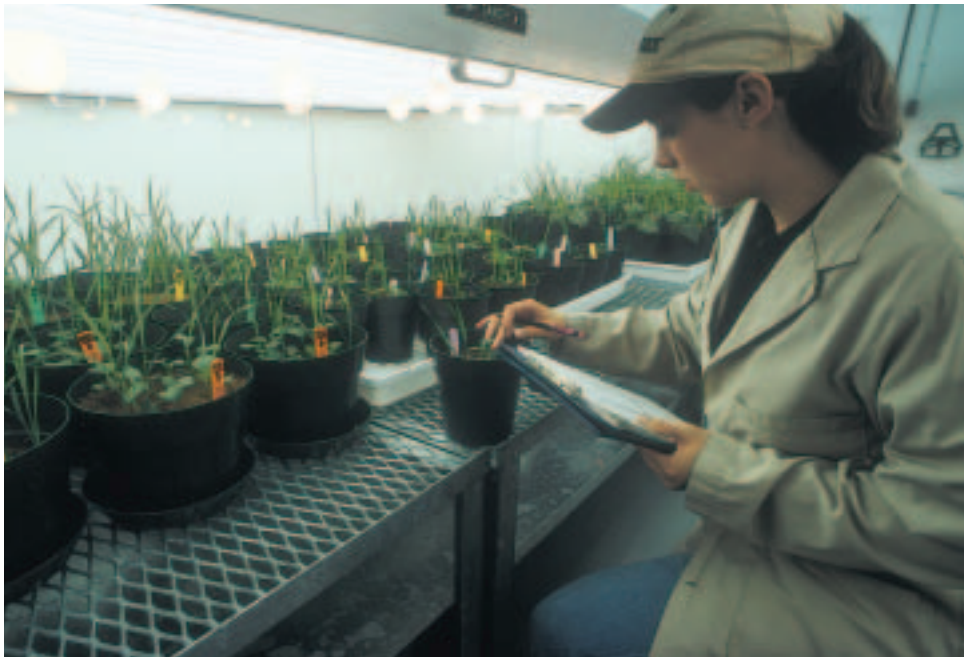


Figure 4.7 Plants can be grown without any soil at all.

A hydroponic system is another type of artificial soil environment. In hydroponic systems, plants are grown without soil. Instead, the roots of the plants are buried in gravel or coarse sand. Nutrient-rich water is then pumped through this material at regular intervals.

mathLink

A canola crop yields 1120 kg of seed per hectare when it is grown without irrigation. An irrigated canola crop yields 1160 kg per hectare. What is the percentage increase in yield?

reSEARCH

Modifying Environments

Find out about other ways to modify environments to increase plant yields.

Check and Reflect

1. What is yield?
2. Describe two methods to make sure plants have enough water.
3. What is an artificial environment?
4. Do you think hydroponics is a good way to grow all plants? Why or why not?

*info*BIT

Varieties of Lettuce

There are at least 40 different varieties of lettuce. Why do you think we have so many?

4.2 New Plant Varieties Are Developed by Selective Breeding

The next time you go into a grocery store, look at the wide variety of fresh fruits and vegetables that we can buy at any time of year. In the past, people had much more limited choices. For example, at one time, most Canadian grocery stores sold only one kind of lettuce. Today you can buy many different types of this leafy vegetable.

Figure 4.8 These two cobs were produced by different varieties of corn.

We grow many different kinds of plants. Most of them were developed by growers and scientists to meet specific demands. The carrot the local farmer grows may have been developed for the short growing season in Alberta. The carrot at the grocery store in the winter may have been developed to stay fresh longer.

Give it a **TRY**

ACTIVITY

A Rose by Any Other Name

The provincial flower of Alberta is the wild rose. Why do the roses that people give on Valentine's Day look so much different from the wild rose? People have been growing roses for centuries. They have reproduced only the roses that they liked the best. Over time, very special types of roses were developed.

Look at the pictures of roses.

Make a list of all the ways these roses are different from the wild rose. Make another list of the ways they are the same. Which characteristics do you think the growers chose to reproduce?

Figure 4.9 Wild rose

Figure 4.10 Taboo rose

Figure 4.11 Peace rose

Problem Solving Activity

The Key to Variety

Materials & Equipment

For each group:

- 1 sample of each of 5 different varieties of a plant (e.g., carnation)
- chart paper or Bristol board
- commercial classification key for reference (optional)

Recognize a Need

You are a plant breeder in a company that produces new plant varieties. Your job is to keep track of the new varieties by making a classification key. A classification key is a diagram or list that organizes the traits of different organisms in a way that allows someone to use it to identify a specific organism.

The Problem

Create a classification key that will distinguish between five different varieties of a plant.

Criteria for Success

For your classification key to be useful, it must meet the following criteria:

- It must distinguish each of the varieties by at least one unique trait.
- It must be clear and easy to use.

Brainstorm Ideas

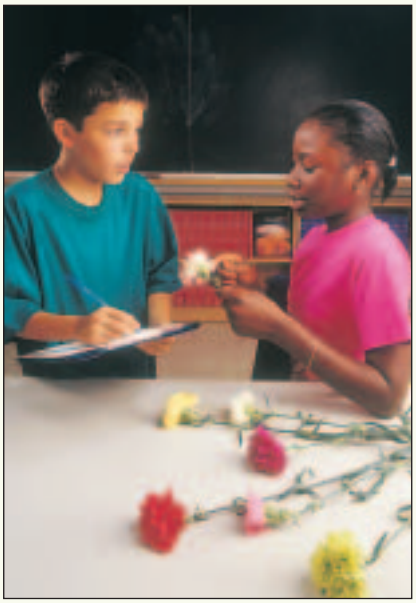
1. Pick up the plants that your teacher has supplied. List all of the traits that are the same and different.
2. Refer to Toolbox 9: Visual Organizers to review the different ways you can organize and present data. You might also look at a commercial classification key. Decide as a group how to organize your list so that it can be used to determine each variety.

Construct a Classification Key

3. Make a classification key using the visual tool you decided upon.

Test and Evaluate

4. Test if you can separate each variety from the other four using your key.
5. Make any changes to your key that are needed, based on the results of your test. Copy your completed key onto a sheet of chart paper or Bristol board.



Communicate

6. Post your classification key in your classroom and compare it with those of your classmates. Did everyone use the same traits? Was the visual tool that others used more or less effective than yours?
7. Write a paragraph describing the process you used to construct your classification key.

RESEARCH

Helpful Hybrids

Most of the plants and seeds you buy are hybrid varieties. Use your school library and the Internet to find out what a hybrid variety is, and why plants are sold this way.

We Grow Particular Varieties of Plants

A **species** is a group of organisms with similar traits that can reproduce with each other. A **variety** is a subset of a species. A variety has specific characteristics, or **traits**, that distinguish it from other varieties.

New plant varieties are produced to provide us with plants that have traits that we need or want. We may need plants that can grow in colder climates, or can tolerate salty soil. Some varieties are more able to fight diseases or attack by insects.

Varieties Are Developed by Selective Breeding

Growers and scientists use **selective breeding** to develop new varieties of plants. Selective breeding is the process of selecting plants with specific traits and reproducing them.

People have been using selective breeding since we first started farming. A farmer might notice that one plant grows taller than the rest. She plants seeds from this plant the next year, and gets more tall plants. If she does this every year, eventually all of her crop will be tall.

Today scientists can also change the characteristics of plants by **genetic engineering**. Genetic engineering is a process in which single genes are added to a plant's cells. A **gene** is a tiny piece of material in a cell's nucleus. Each gene in a cell is responsible for the inheritance of certain traits or characteristics. In genetic engineering, the added gene can come from other plants or from totally different living things.

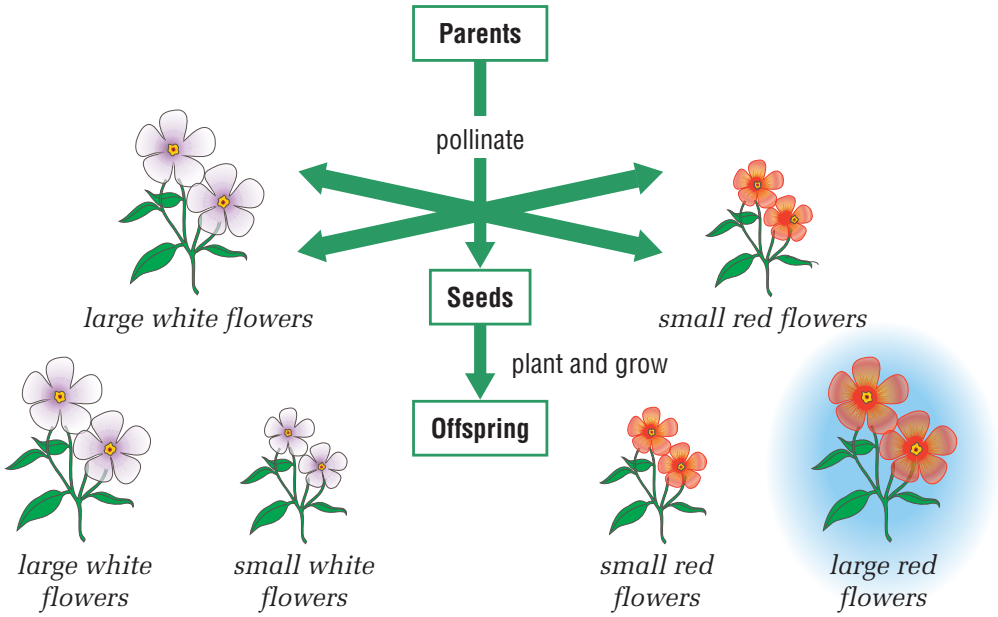


Figure 4.12 The traits of the parents are selected first, then the offspring. Some of the offspring of these plants will have flowers that are both large and red.

New Varieties Can Cause New Problems

Although new varieties have useful traits, they may also require more fertilizer or other special treatment. For example, an increased use of pesticides may be required if the new plant variety is more attractive to pests. This can be expensive for the farmer. As well, it may be harmful to the environment because the food web may be disrupted.

In western Canada, canola (an oilseed crop) is grown. The yellow flowers produce pods containing tiny round seeds. Each seed contains about 40% oil which is valued because of its health benefits. Through genetic engineering, canola plants can be protected against insect damage and some herbicides. There is some concern that canola plants might cross-pollinate with wild mustard and produce a "super weed." A super weed might not be easily controlled.

Figure 4.13 Some varieties are more attractive to pests.

Check and Reflect

1. What is a variety? Give an example.
2. Explain selective breeding.
3. You find a Saskatoon bush growing wild that has large, sweet berries. What could you do to produce more bushes that have exactly this kind of berry?
4. Why do we need to produce new varieties? Give at least two examples in your answer.
5. Why is it hard to produce new varieties of trees?

Careers and Profiles

Plant Pathologist

Allan Kuzyk is a plant pathologist in the Department of Agriculture and Agri-Foods at the Lethbridge Research Centre. Allan studies cereal diseases and tries to find new ways to fight them. He passes his results on to other scientists, agricultural workers, and the general public. Allan also helps to develop new varieties that do not get diseases very easily.

- People who study plant diseases can work in agriculture, horticulture, or forestry. Do you know someone who knows about plant diseases?

Figure 4.14 To create new varieties, Allan sometimes has to pollinate plants by hand.

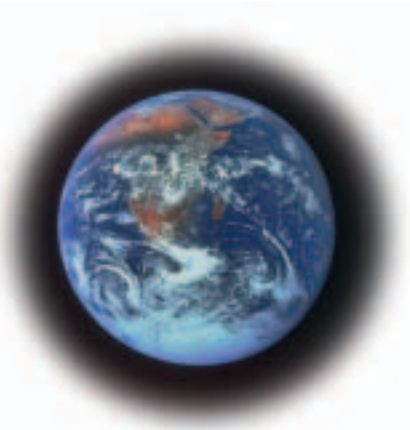


Figure 4.15 Many of the ways we grow and harvest plants can have global consequences.

4.3 Controlling Weeds and Pests

As you look at this picture of our planet taken from space, consider how all life on Earth shares the same global environment. Within this web of life, some living things are considered useful to humans. Other living things are considered harmful or at least a nuisance.

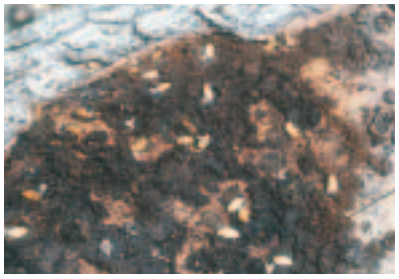
In commercial crops, plants that interfere with the growth of these crops are called weeds. For example, crop losses can result from weeds such as wild oats, quack grass, green foxtail, and smartweed. Animals that eat or affect the growth of commercial crops are called pests. For example, the army cutworm larva eats the leaves of many plants, including wheat, oats, barley, mustard, flax, alfalfa, peas, cabbage, and grasses.

Weeds and pests do have a role in the environment, but farmers must produce a variety of crops for human consumption. To meet consumer demands, farmers must maximize crop yield. To do this, they must control weeds and pests.

*info*BIT

Bark Beetles

Bark beetles damage many trees in Alberta. They tunnel under the bark of trees to lay their eggs. These tunnels allow diseases to enter the trees and weaken or kill them.



Give it a TRY — ACTIVITY

What's the Real Story Here?

Read the situations below. In a paragraph, write a story that links these situations together.

- Weeds grow in a field of oats, which reduces yield.
- Insects eat some of the weeds.
- Birds eat some of the insects.

Now add another paragraph to describe what happens when a farmer sprays a chemical to kill the weeds.

Did the farmer's action have any consequences?

Controlling Weeds with Herbicides

Herbicides are chemicals that kill plants. Gardeners use herbicides to kill weeds to produce beautiful lawns and flower beds. Farmers use herbicides to kill weeds and selected plants. This allows farmers to choose and grow a single crop in a field. One of the advantages of having one single crop is that the individual plants mature around the same time and make harvesting easier. However, herbicides can cause problems. For example, some weeds are the food source of other living organisms. Killing these weeds may cause those organisms to starve. The build-up of herbicides in the soil can make the soil less fertile for certain plants. Any herbicides that get washed into streams and lakes may be harmful to living things in these water environments.

Figure 4.16 Canola plants that are herbicide-resistant can pollinate with their wild relatives. These weeds are now resistant too, and are more difficult to control.

When a herbicide is used for a long time, some weeds become resistant to it. The next time the herbicide is used, the resistant weeds will have fewer plants to compete with and may take over. New herbicides must be developed to prevent this problem.

Controlling Insects with Pesticides

Substances that kill insects are called **pesticides**. Farmers use pesticides on their crops to protect them from harmful insects. Pesticides can sometimes kill helpful insects as well, such as those that pollinate crops. Used carefully, pesticides help farmers increase yields. Care must be taken not to contaminate the environment with pesticides.

When pesticides are used for a long time, some insects will become resistant, and the pesticide becomes less useful. New pesticides must then be developed to control the resistant insects.

Many pesticides are still on food when we buy it from the grocery store. This is why it is important to wash fruits and vegetables before eating them.

Figure 4.17 Pesticides used to control harmful insects on crops are killing many monarch butterflies every year.

rESEARCH

Controlling Mosquitoes

Some communities spend a lot of money trying to control mosquitoes. Using your school library, the Internet, or other resources, find out if mosquitoes are being controlled in your community. In your opinion, is your community doing the right thing? Explain your answer.

Figure 4.18 Ladybugs can be used to control aphids.

Biological Control

Sometimes, a natural predator is used to control a pest. This method of pest control is called **biological control**. Biological control tries to copy the way that population size is controlled in natural environments.

Biological control does not get rid of all the pests. Instead, the predator changes the balance in the environment so that there are fewer pests. Biological control also takes a while to work. This method isn't useful for large outbreaks of pests.

Check and Reflect

1. Explain what happens when a pesticide is used for a long time.
2. What are herbicides used for? Describe one consequence of using herbicides in agriculture.
3. Describe biological control.
4. Explain why you agree or disagree with the statement "Pesticides are more helpful than harmful."

4.4 Consequences of Environmental Management

Have you ever done something you thought would be a good thing, and then found out that you actually did something harmful? Maybe you decided to weed the flower garden for your parents and you pulled out some new prized seedlings along with the weeds. This is an example of an **unintended consequence**, or something that you didn't predict would result from what you did. Unintended consequences often happen when we don't know or don't think about all the factors in a situation.

Discuss with a partner any experiences you have had with unintended consequences. When you listen to your partner, think about possible reasons why things didn't turn out as expected.

Give it a **TRY** ACTIVITY

INTENDED AND UNINTENDED CONSEQUENCES

Sometimes when we try to be helpful, we end up doing things that just make more trouble. These unintended consequences might not have happened if we knew more about the situation or had taken more time to think about it.

For each of the situations in the list below, predict the consequence. Was this consequence intended or unintended?

- A large man is leaning out on a very small tree branch trying to reach his cat.
- A girl pushes a door open for her friend, but doesn't notice her teacher is on the other side.
- A community group decides to clean up a stream in the spring. They walk through the nesting area of an endangered bird as they are collecting garbage.

SOME PRACTICES HAVE UNINTENDED CONSEQUENCES FOR THE ENVIRONMENT

Environmental management is balancing the needs of humans with the needs of the environment. It can involve many different technologies and ways of using resources. When we use technologies to manage an environment, we need to look at all of the effects of the technology—not just the intended effects.

*info*BIT

A Pond Without Reeds

All the reeds and other water plants have been removed from this pond. Now ducks have nowhere to nest here.

Figure 4.19 Human activity in the wilderness may cause some animals to move away.

When forests are being logged, roads must be built to help bring in people and equipment. Animals such as elk and moose also use these roads, since they provide convenient paths from one location to another. For the same reason, predators may also use the roads. So, the introduction of roads often may have the unintended consequence of making the habitat less secure for some species.

People other than foresters also use motorized vehicles like snowmobiles and all-terrain vehicles on logging roads. Although they may be enjoying the wildness of these remote areas, their presence may cause some animals to move away from the area to avoid human contact. The repeated use of these areas by human activities may make the habitat less secure for a number of species. While humans can use these areas for various purposes, it is important that we be sensitive to other species that share the landscape.

Monoculture

In farm management, each planted field will often be used to support growth of just one variety of plant. This is called **monoculture**. All the plants are very similar or even identical to each other. Growing plants by monoculture can cut down on costs and fertilizer overuse. It can also make harvesting a crop a lot easier. These are the intended consequences of monoculture.

Unfortunately, monoculture can also give pests a huge supply of their favourite food. This can cause the population of pests to explode, and result in much more pesticide being used. Monoculture also reduces the **biodiversity**, that is, the number of different species, of the environment, since only one kind of habitat is available.

Problem Solving Activity

Reducing Our Impact

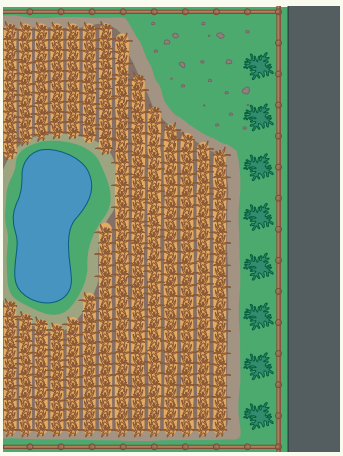


Figure 4.20 This year's barley field has some unused areas.

Recognize a Need

You are a grain producer with a large, independently operated farm. You just read a magazine article about the loss of biodiversity, or the number of different species, in Alberta. You've decided to review how you manage your barley field, and evaluate whether anything you do has the unintended consequence of reducing biodiversity. You then want to develop a strategy that will reduce this effect, but won't reduce the productivity.

The Problem

To identify one or more ways to improve habitat for wildlife without harming the productivity of a barley field.

Criteria for Success

To be successful, the proposed changes must meet the following criteria:

- Life-supporting habitat for wild species would be recovered.
- Barley production would not be affected.

Brainstorm Ideas

1. In a group, identify example species that would already occupy existing habitat (i.e., the pine trees, pond, and rocky area). Identify others that may not be present but might be supported through habitat change.
2. Generate a list of proposed strategies for habitat enhancement. Select two for testing.
3. For each habitat development strategy, propose what wild species might be positively affected by this habitat change.

Test and Evaluate

4. For each proposed habitat change, research and report on the needs of those animals as a way of providing evidence that the proposed habitat change would be effective for that species.
5. Identify particular strengths and weaknesses of this habitat for each species named.
6. Identify one or more habitat changes that your group suggests would have the maximum impact.

Communicate

7. Write a report that summarizes your work. Explain the reasons for all the decisions you made. You might want to use a map in your report too!

rESEARCH

More or Less?

For most crops being grown today, only a few varieties are grown worldwide. Use the Internet and other resources to find out about biodiversity, and what consequences growing a limited number of varieties could cause.

Sustainable Management

Unintended consequences are often difficult to predict. The more we know about the organisms in the environment and how they are linked to one another, the less likely we are to accidentally cause harm. We can then manage our plant resource in a way that can be continued, or **sustained**.

Economic and Social Effects

Sustainable ways of producing plants can also have some consequences other than helping the environment. Think about crop rotation. It breaks insect and disease cycles, improves soil structure, controls problem weeds, and improves yields by up to 15%. Rotating crops prevents the continued depletion of certain nutrients in the soil which would occur if the same crops were planted year after year. In western Canada, farmers are examining and growing alternative crops such as canola, lentils, and peas because of the potential benefits. Legumes (peas and beans) grown in the rotation increase a subsequent crop grain yield and protein content. Crop rotation makes economic sense.

Since crop rotation keeps the soil healthy, a farmer can keep producing crops for a long time. This can help to provide steady jobs for the people who work for the farmer. Because they can rely on their jobs, these people can stay in the area and help to build the community they work in. This is an example of social effects of sustainable practices.

Check and Reflect

1. What do we mean when we say something is sustainable?
2. What is monoculture? Give an example.
3. A grower decides to change from using pesticides to using biological control. Suggest one environmental, one economic, and one social consequence that his or her decision could have.
4. Describe at least one thing that you could do in your local area that might improve the environment. Do you think you might actually do this? Why or why not?

Assess Your Learning

1. What is selective breeding?
2. Give three examples of different species of plants. Give three examples of different varieties of plants.
3. Do you think that plowing an empty field is a good practice? Why or why not?
4. Why do we need to produce new varieties of plants? Use at least one real-life example in your answer.
5. Give an example of an unintended consequence of human activity in a managed forest.
6. Describe one intended consequence of monoculture.
7. Write a short paragraph of three or four sentences that describes sustainable agriculture.
8. Growing and harvesting plants in ways that sustain agriculture and the environment is very important for the whole planet. Do you agree with this statement? Why or why not?

Focus On Science and Technology

In this section, you were introduced to some examples in which a technology that was intended to be helpful also had harmful consequences. Although we can never predict all consequences, making sure we have "done our homework" and learned as much as we can will reduce how often this happens. Think about the knowledge that would be needed to use a herbicide or pesticide safely and effectively.

1. What would you need to know about the local environment?
2. What should you do to try to prevent unintended consequences of using a herbicide or pesticide?

SCIENCE WORLD

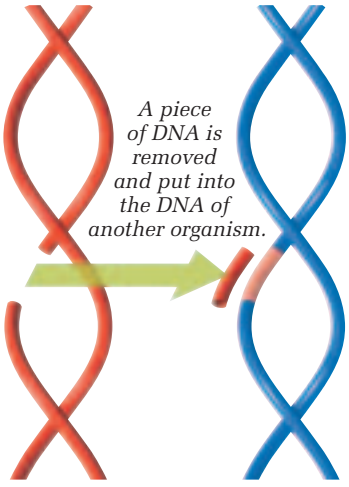
Case Study

Genetically Modified Organisms

The Issue

Some varieties of our crops were produced by genetic engineering. For example, some corn and potatoes are genetically engineered to have protection against insect damage. Corn, squash, and sweet potatoes have been "vaccinated" so that they are resistant to viral plant diseases. Some tomatoes have been treated to permit vine-ripening for better flavour and longer storage. Swiss researchers have produced a rice that will satisfy the daily requirement of vitamin A and provide more iron. This would help people in developing countries who have vitamin A and iron deficiencies. In the U.S. there are test fields of tobacco plants producing a potential AIDS drug.

Genetic engineering is a process in which a piece of **DNA**, or genetic material, is moved from one organism into an entirely different kind of organism. The piece of DNA gives the new genetically modified organism, or **GMO**, a new trait.



By moving around pieces of DNA, scientists can give plants new traits.

However, many people are concerned that GMOs will have unintended consequences. For example, the "super weed" described earlier in this unit developed when canola plants were grown as a crop.

Many countries are refusing to buy any products that have been genetically engineered. In fact, when a company from Winnipeg accidentally shipped canola seed that contained 0.4% of genetically modified seed to Europe, the farmers who received it ripped up their entire canola crop to prevent it from flowering.

Some people argue that GMO experiments are not safe because scientists do not yet fully understand the interactions between organisms and the ecosystems. They say that herbicide-tolerant plants encourage more reliance on chemical weed killers. This in turn puts more chemicals on our food and in the groundwater. Other comments have to do with the fear of altering genes in a food crop and changing the nutrient value or producing something poisonous or allergenic.

Go Further

Now it's your turn. Look into the following resources to help you form your opinion about whether Canada should continue to allow our farmers to grow GMOs in their fields.

- Look on the Web: Check out the rules Canada has about GMOs.
- Ask the Experts: Try to find an expert on genetic engineering. Experts can be found in many places: universities, environmental and agricultural organizations, or government agencies.
- Look It Up in Newspapers and Magazines: Look for articles about GMOs.
- Check Out Scientific Studies: Look for scientific studies about the safety of GMOs.

In Your Opinion

Summarize your findings as one of the following:

- an article for your local or school newspaper
- a speech to be presented at a forum on this issue
- a poster

Unit Summary: Plants for Food and Fibre

Key Concepts	Section Summaries
1.0 • life processes and structure of plants • plant propagation and reproduction	**1.0 Understanding structures and life processes of plants helps us to interpret their needs.** • Seed plants have roots, stems, leaves, and either flowers or cones. Each structure has a specific function. • To maintain their life, plants use the processes of photosynthesis, transpiration, and gas exchange. • Seed plants have three different stages in their life cycle. These are the seed stage, the seedling stage, and the adult stage. • For adult seed plants to produce new seed, they must be pollinated. Pollination is the joining of pollen and ovary. • Seed plants can be reproduced in ways that don't involve seeds. • The structures of seed plants are adapted to the environment they come from. These adaptations help the plant to get what it needs from the environment. • Different types of plants require different growing conditions. We have technology that can modify the environment to suit the plants we grow.
2.0 • needs and uses of plants • resource management	**2.0 Plants play an essential role in the environment and in meeting human needs.** • Plants supply oxygen and food to most of life on Earth. • Humans use plants for food, for fibre to make many of the things we need, and for medicines and other products. • As we use more plants, we convert natural living resources to managed living resources. There are fewer species in managed environments.
3.0 • fertilizers and soil nutrients • resource management	**3.0 Soil is an important resource that human activity can protect or degrade.** • Soil is composed of particles of minerals and organic material. The amounts of these particles determine if the soil is sandy, clay, or loam. • The methods we use to grow and harvest plants can improve soil or degrade it.
4.0 • plant varieties • selective breeding • monocultures • resource management • sustainability • chemical and biological controls	**4.0 The ways that plants are grown and used are related to human needs, technology, and the environment.** • New plant varieties are produced by selective breeding. New varieties have traits that we want, such as higher yield and pest-resistance. • New varieties can require additional fertilizer or water, which can lead to environmental problems. • Using herbicides and pesticides long term can lead to the development of resistance. It can also cause loss of helpful species or pollute the soil. • Sustainable practices balance our needs with the needs of the environment. We also must balance the social and economic consequences of changes that we make.

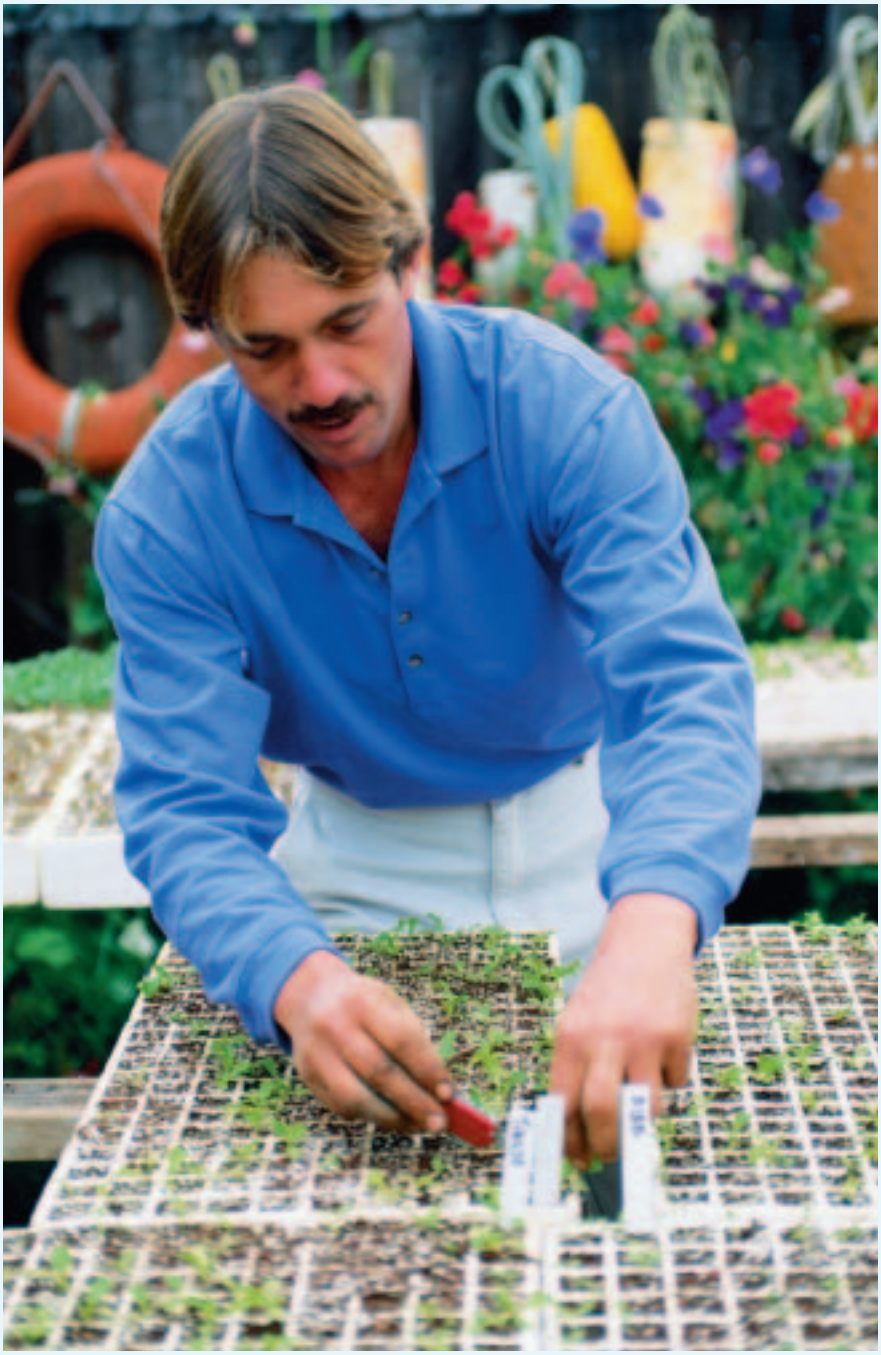
PROJECT

Design and Build a Growth Chamber

Getting Started

In this unit, you have learned that we need plants for food and fibre, and that plants also provide oxygen and food for most of life on Earth. You learned about the needs of some plants and some of the technologies that we use to modify the environment to grow plants.

Some of these technologies are very important to Albertans. Since you live in Alberta, you know the growing season is short. To get a head start on your vegetable garden, you could design and build a growth chamber. This chamber could then be used to grow some seedlings that would be transplanted into your garden at the appropriate time.



If growing season is short, many gardeners start their seeds indoors to get them growing.