1.5 Plant Needs and Growing Conditions

All plants need the right amount of light, water, nutrients, and space in order to survive. Seed plants also need to be pollinated and produce seeds. The seeds must germinate at the right time in a place that will supply all their needs.

The rice plants in Figure 1.33 look healthy because they have all the things they need. Rice plants must grow in water. Other plants, such as wheat and corn, could not survive in these conditions.

Figure 1.33 Rice plants

Give it a **TRY** ACTIVITY

PLANTING A VIRTUAL GARDEN

You and your friends are planning to grow a flower garden in a community park close to your school. The space you have been given is half in bright sunlight and half under the shade of a big tree. The park gets lots of rain, but you have noticed that the area under the tree stays dry for a long time.

Here are the tags from the plants that you and your friends like the most. Choose no more than two plants that you think would grow well in your garden.

Explain why you chose each plant and where you would plant it in your garden. Do you think you could plant your whole garden with just one of these plants? Why or why not?

*info*BIT

In the Hothouse

Plants grown in greenhouses grow faster, bigger, and produce more flowers or fruit than plants grown outside.

Plants Need Different Amounts of Light

All plants need light in order to photosynthesize and produce food. But they don't all need the same amount of light. Some plants need lots of light and others need shade. For example, a fern needs less light than a marigold does.

Plants Need Different Amounts of Water

You know that a plant will die if it doesn't get enough water. But plants can also get too much water. Plants that are adapted to grow in very dry conditions, like cactus, are easily damaged or killed by too much water. Others need lots of water all the time.

Plants Need Different Nutrients

Plants need nutrients from the soil for healthy growth. **Nutrients** are substances that provide the energy and materials that plants need to grow. The main nutrients that plants need are:

- nitrogen
- phosphorous
- potassium
- calcium
- magnesium

If plants do not get enough of these nutrients, they will grow slowly and will not develop properly. For example, if plants do not get enough nitrogen, their leaves will be yellow instead of green.

Not all plants need the same amount of nutrients. For example, plants such as beans, peas, and clover can take nitrogen from the air instead of the soil.

Plants Need Different Amounts of Space

All plants need enough space to grow. Some types of plants need more space than others. Small plants like the buttercups in Figure 1.34 require very little space for each plant. Huge trees like the redwoods in Figure 1.35 require large amounts of space to collect the sunlight and nutrients that they need to grow.

Figure 1.34 Buttercups

Figure 1.35 Redwood trees

Inquiry Activity

Investigating Growing Conditions

Materials & Equipment

- soil
- small containers for growing plants
- graduated cylinder or beaker
- radish seeds
- ruler or measuring tape
- water

Figure 1.36 What will "best" mean for the growth of your plants?

The Question

Does the amount of water a radish plant receives affect its growth?

The Hypothesis

Write a hypothesis about the effect of different amounts of water on how well a radish plant grows.

Procedure

1. In your group, develop a fair test for your hypothesis. Read Toolbox 2—The Inquiry of Process of Science if you need help in developing a fair test. Remember to identify the manipulated and responding variables. You will need a method for measuring the change in your responding variable. For example, if your manipulated variable is the amount of water added to the plants, the responding variable may be the height of the plants. You will need a device to measure the height of the plants.
2. Write out your procedure. Remember to include a table or chart that will allow you to record your data over the next several weeks. Have your teacher approve your procedure.
3. Determine the materials you will need for your procedure.
4. Carry out your procedure. Make sure everyone in your group understands their roles and can carry out their part of the procedure when necessary. For example, measurements must be taken and recorded at set times.

Collecting Data

5. Record your data in the data table you designed and your teacher approved.

Analyzing and Interpreting

6. Review the data you recorded. What volume of water created the best growing conditions for radish seeds? What volume of water created the worst conditions?
7. Was your hypothesis correct? Does it matter if your hypothesis was right or wrong?
8. Create a graph or chart illustrating your data. Your graph or chart should clearly show how much water was added to each plant and the results during the investigation.

Forming Conclusions

9. Write a short report describing your test and what you found. Include your graph or chart in your report. Describe any changes you would make to your test if you could do it again.

Figure 1.37 This plant got everything it needed to grow!

Growing Healthy Plants Requires Knowing the Best Growing Conditions

Knowing about the needs of different plants is an important tool for growing plants. If you know exactly what a plant needs at each stage of its life, you might be able to make sure it grows under exactly those conditions.

Check and Reflect

1. Do all plants need to get the same amount of light? Explain your answer.
2. Name two plants that need very different amounts of water.
3. You have a plant that needs lots of water and light. How will you give this plant the best growing conditions?
4. Give an example of a job that might require knowing a lot about the different needs of plants. Do you think you would like to do this job?

Assess Your Learning

1. Name the parts of a seed plant. For each part, write one sentence describing what that part does.
2. Describe the process by which plants make food. Where does this process take place?
3. Give two examples of variations in the structure of stems.
4. Look at the pictures of the plants below. How are these plants adapted to their environments?

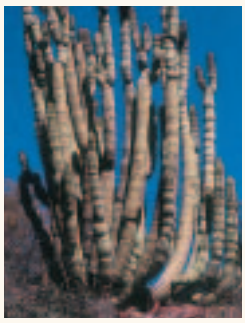


Figure 1.38

Figure 1.39

Figure 1.40

5. Choose a plant you are familiar with. Draw the stages in the life cycle of that plant.
6. Think about your backyard or a park near you. Suppose you are going to plant some flowers there. What do you already know about this area that would help you decide what kinds of flowers to choose? What things would you have to find out?

Focus On Science and Technology

In this section, you have studied the needs, structures, and life processes of plants. You have also examined different ways that plants adapt to their environments. Such scientific knowledge can lead to the development of new technologies. These technologies can be then used to make more scientific discoveries.

1. Describe why an understanding of the needs of plants is useful to humans.
2. Describe an example of a plant technology that was developed from an understanding of the needs of plants.

2.0

Plants play an essential role in the environment and in meeting human needs.

Key Concepts

In this section, you will learn about the following key concepts:

- needs and uses of plants
- resource management

Learning Outcomes

When you have completed this section, you will be able to:

- explain the role of plants in the environment
- describe ways that humans use plants
- describe natural and managed living resources in various areas
- identify examples of local and global change in living resources

We live in a world of plant life.

Plants live all around us. They grow deep under the ocean, on the sides of mountains, under arctic snow, and in hot, dry deserts. Plants are in almost every kind of environment on Earth.

Plants are necessary to all life on Earth, and they supply us with many things we rely on. To be able to meet our needs in the future, we must make sure that the things we do to grow and harvest plants do not interfere too much with the needs of the rest of the planet.

2.1 The Role of Plants in the Environment

Figure 2.1 What lives in the environment around your school?

Many living things make your schoolyard their home. Plants are an important part of this environment. For example, plants provide a home and food for many different types of birds and insects. But plants have much wider ranging effects as well. They even affect the air you breathe.

***info*BIT**

Plants Across Canada

Vegetation (plant) cover in Canada can be classified into four categories: forest, tundra, barren, and agriculture. The remaining areas of the country are either non-vegetated areas (without plant cover) or water.

***Give it a* TRY** ACTIVITY

NATURE'S CONNECTIONS

Make two lists, one of the plants and one of the animals in these photographs. Discuss with a partner how each plant and animal might be connected. Draw lines on your lists between those you think are connected.

Share your work with another pair of students. Explain what you think the plants provide for the animals. Do you think these animals would survive without the plants?

Figure 2.2

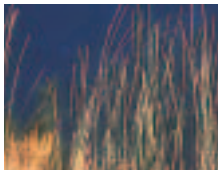


Figure 2.3

Figure 2.4

Figure 2.5

Figure 2.6

Figure 2.7

Problem Solving Activity

Why in the World Do We Need Plants?

Recognize a Need

A neighbourhood committee is improving the area around your school. Most people want to add more plants, but some committee members think it would be easier just to pave the area.

You've been asked to help convince everyone on the committee that plants are essential to the environment. They want you to find examples of plants around your school that are used for food by other living things, create oxygen and remove carbon dioxide from the air, provide shelter for living things, and make or protect the soil. You will prepare a written report for the committee.

The Problem

Explain the essential role of plants in the environment using examples from the area around your school.

Criteria for Success

For your presentation to be successful, it must

- have an example of each of the four ways that plants help the environment
- describe what would happen to the environment if plants were not present
- be creative and convincing

Brainstorm Ideas

1. Working with your group, discuss where you might find the examples you need. Will you look in one area, or in four different areas?
2. Decide how you will record the examples you find. Consider how you will present the information. Is it better to make sketches or prepare a table?

Caution!
Be kind to the environment when you make your observations. Do not remove anything, and be careful not to harm the living things you find.

Prepare and Evaluate

3. Find and record the examples you need. As you are working, evaluate whether you have chosen an appropriate method to record your observations. If not, modify your method.
4. Back in class, discuss as a group what would happen if plants were not present in each of your examples.
5. Decide on the best way to present your work.

Communicate

6. Prepare your report. Remember that it must convince people that plants are important to the environment.

Extending

Draw a map of your schoolyard that shows where different types of plants are found. Use a field guide or identification key to identify any plants you are not sure about.

Check and Reflect

1. Explain why animals need plants to survive.
2. Pretend that half of the plants on earth suddenly disappeared. What do you think might happen to the air?
3. Why are plants important for soil?

Figure 2.8 All organisms in this environment depend on plants.

*info*BIT

Help for Headaches

The bark of the willow contains a chemical that is similar to acetylsalicylic acid (Aspirin). Willow bark was one of many plants used by some First Nations and Inuit peoples as a source of medicine.

2.2 We Use Plants in Many Ways

Aboriginal people in Canada used many plants for food, fibre, and medicines. For example, paintbrush was used to treat rheumatism, and its flowers could be eaten as a sweet treat.

Plants provide us all with food, and with fibre that we use to make shelter, clothing, and other useful products. Plants can also provide us with medicine.

You use plants in different ways every day. All day long, you eat plants in every snack and meal. When you put on a cotton T-shirt, you're using a plant product. This book is made from plant fibres.

Figure 2.9 Paintbrush grows throughout Alberta.

Give it a **TRY** ACTIVITY

When Is a Tree Not a Tree?

You use plants every day. Maybe you eat some fruit, or play soccer on grass, or just enjoy a potted plant in your home. But there are lots of other uses for plants that you might not have thought about before!

Copy out the list below. For each item, write the name of at least one plant that can be used to make that item.

- pencil
- paper
- perfume
- skin care lotion
- baseball bat
- bread
- table
- throat lozenges
- T-shirt
- rope
- dog food
- house

When you have finished, exchange your list with a partner. Did you both name the same plants for every item? Discuss with your partner any answers you do not agree with.

Plants for Food

Plants can provide us with the food we need to stay healthy. A diet with lots of fruits and vegetables can help protect us from some diseases.

Plants for Fibre

Fibre from plants provides many of the materials we use for shelter and warmth. Most houses in Canada are made of wooden frames covered with sheets of wood. The fibres from some plants are used to make cloth. For example, cotton fibre is used in shirts and jeans. Plant fibre is also used to make paper and paper products. Your notebook and this textbook are made from plant fibre.

rESEARCH

Make Good Use of It

Some of the plants in your area might be used for food, fibre, or medicine. Use books, the Internet, and other sources to find what plants in your area are used for.

Figure 2.10 Plant fibres are used to make all these things. How much do you think our lives would change if we couldn't get fibre from plants?

Figure 2.11 The kinnikinick or buffalo berry plant was used by First Nations, Métis, and Inuit peoples to treat kidney problems.

Plants Can Be Used in Many Other Ways

Plants have always been an important source of medicine worldwide. In Canada, the Aboriginal people used more than 500 different kinds of plants for medicine. In 1535, Iroquois people cured Jacques Cartier's expedition of scurvy with a tea made from white spruce and hemlock. Scurvy is caused by not eating enough vitamin C.

There are many other uses for plants. Plants can be used to make glue and rubber. Plants are used to put the shine on glossy paper, the colour in this textbook, and the odour in perfume. Plants can even be used to clean up polluted soil!

Check and Reflect

1. Name two ways that we use plants. Give an example of each.
2. Describe two ways that plant fibre is used.
3. What kind of plant is used to make paper? Are there any other ways that this plant is used?
4. Was there any way that we use plants that surprised you?

Careers and Profiles

Syrup Producer

You've probably tried maple syrup that comes from sugar maple trees that grow in eastern Canada. Warren Bard of Edmonton makes syrup from birch trees. "It has a totally unique flavour," he says about his syrup.

Figure 2.12 Warren Bard has found a way to make a business out of the natural resources in his area.

Warren began to experiment after he read about a Yukon cook who opened a breakfast place during the Gold Rush. This cook had no sugar, but a First Nations woman taught her how to tap birch trees for the sweet syrup.

In 1998, Warren's birch syrup was used by Culinary Team Canada to create a dessert sauce that won a silver medal in an international cooking contest. His syrup is used in major hotels such as the Banff Springs Hotel and the Hotel MacDonald in Edmonton.

1. How might developing new uses for native plant species help the environment?
2. What people outside the school would you contact to help you start a new business?

2.3 Managing Living Resources

Figure 2.13 Forests are an important living resource.

Living resources are living things that can be used for human needs. Forests, like the one in Figure 2.13, contain living things that are part of Earth's living resources. These include not only the trees, but many other plants and animals found in forest environments. When we cut timber or use the forest as a place for recreation, we may affect these living things. Managing living resources like forests involves maintaining healthy populations of all the living things that make up those resources.

*info*BIT

Protecting Living Resources

Prickly pear cactus grows in the living resource of the Badlands in Dinosaur Provincial Park.

Give it a **TRY**

ACTIVITY

USING A LIVING RESOURCE

Working on your own, put a line down the middle of a piece of unlined paper. On one half of the paper, sketch a picture of an area that you think is a living resource. For example, you might draw a local woodland or a prairie grassland. Include as many different kinds of plants and animals as you can.

On the other half of the paper, sketch the area as it might look after humans begin to use the resources as a park.

Look over your finished sketches. Note three differences and write them down in point form below your sketches.

Problem Solving Activity

Communicating Ideas About a Managed Resource

Figure 2.14a) Mammals such as the pine marten use mature forests to meet their basic needs.

Figure 2.14b) Humans need forests to provide building materials and many other basic needs.

Recognize a Need

You are a member of a group called Students for a Healthy Environment. Your group is preparing a pamphlet to help people understand why managing the living resources of a forest is important. You want to explain that there are many different forest uses, and all the living resources in a forest must be looked after.

The Problem

Design an attractive and easy-to-read pamphlet that explains how a forest region is used. These uses include timber production, recreation, and habitat for plants and wildlife. You may focus your pamphlet on a region of Alberta or another part of the world. Explain why areas are set aside for particular uses. Describe ways that people can help look after the living resources of the forest.

Criteria for Success

For your pamphlet to be effective, it must

- present accurate information about the uses and living resources of forests
- include graphics that demonstrate the variety of uses
- give examples of human activities that work to restore forests as a sustainable resource

Brainstorm Ideas

TOOLBOX

1. In a group, list the facts you need for your pamphlet. Use your textbook, the Internet, or your school library to check any information you aren't sure about.
2. Decide as a group which facts can be presented as a graph. Use Toolbox 7: Graphing to help you decide.

Make a Pamphlet

3. Decide what materials you will need to make your pamphlet. Think about what size and shape would work the best.
4. Arrange the information you will be including in your pamphlet so that it looks attractive. Consider adding related pictures.

Test and Evaluate

5. Display your completed pamphlet in your classroom.
6. Compare your pamphlet with the pamphlets that other groups prepared. Are there any features in their pamphlets that work particularly well?
7. Evaluate your work. If you had time, is there anything you would change to make your pamphlet more effective?

Communicate

8. Post your pamphlet, along with the other pamphlets, in your class. Spend some time reading each of the pamphlets and taking notes. As you read each pamphlet, provide constructive feedback and suggestions for improvement.

Changes Caused by Human Activity

The first people to use living resources in Alberta were the Aboriginal peoples. They obtained the food and fibre they needed by hunting and gathering. Plants, such as the wild rose, were used not only as a source of food, but for medicine as well. They also developed methods for encouraging the growth of plants they needed by clearing some areas with fire. Aboriginal peoples developed a close relationship with the land because of their use of living resources.

Major changes in living resources began with the introduction of horses and guns for hunting. These new technologies allowed Aboriginal peoples to hunt buffalo and other animals more efficiently. Horses also competed for grazing with animals such as the buffalo. Both activities affected the living resources.

Figure 2.15 Siksika Nation people in Alberta used horses for hunting.

Figure 2.16 European settlers used larger amounts of living resources in different ways.

When European settlers came, they began to clear and farm land to grow food for themselves and others. They logged the forests to supply wood for building and fuel. With greater use of the living resources, the need to manage these resources became greater.

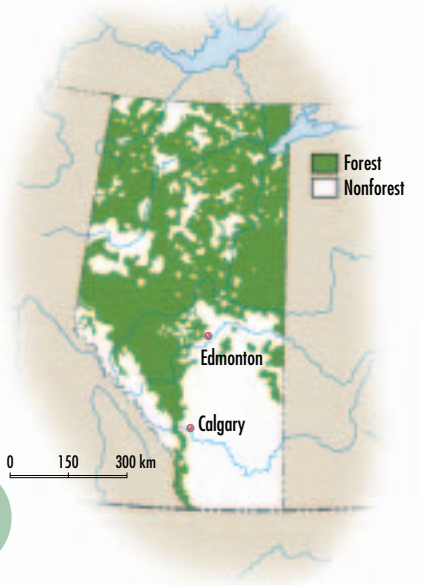


Figure 2.17 This map shows the amount of forest in Alberta today.

Managing Living Resources for Now and the Future

As the world's population keeps growing, so does the demand for natural resources. In some parts of the world, forest resources are being used more quickly than they are being replaced. This kind of use is said to be non-sustainable. This means that the amount being used now will not be available in the future.

Over time, people have used the forests to provide wood fibre for things such as building materials, paper, and fuels. The practice of managing forests has changed as our needs and demands on this sustainable resource change. People work to use forests in ways that will ensure a balance between meeting our needs and the needs of the many species that call forests home.

Agencies that manage forest resources establish methods and regulations that foresters follow when a forest is to be harvested. These regulations provide a framework to identify what species are to be harvested, how they are removed, and how the forest is restored and replanted after harvesting. This framework ensures that foresters can obtain the species they want for their products, and secures the forest to remain healthy and renewable. Human activities such as logging and replanting allow forests to pass through different growth cycles over time. Different plants and animals will use these changing environments as the forests develop from one stage to the next.

Figure 2.18 People manage forests to maintain a diversity of species and to keep the forest healthy and productive.

Check and Reflect

1. What is a living resource? Give three examples.
2. What are the challenges associated with managing a living resource such as a forest?
3. What did you find out about how humans affect the environment that you didn't know before? Is there anything in this section you would like to learn more about?

Assess Your Learning

1. Explain why plants are essential to the environment.
2. Name four ways that humans use plants. Provide an example of each use.
3. Think about the area where you live. Describe changes in the natural living resources that might have resulted from the following human activities.
   a) Aboriginal peoples collected food.
   b) European settlers cleared land to farm.
   c) New houses are built for new people coming to Alberta.
4. Do people depend on plants as much as they did in the past? Explain your answer.

Focus On Science and Technology

Through technology, we find new ways to grow and use plants. Think about what you learned in this section.

1. Explain two ways in which the practice of planting small trees after an area has been logged helps the environment.
2. What are some of the ways we produce plants? Have they changed as we have developed new technology?
3. The technology we use changes over time. Choose a tool used in agriculture or forestry such as a corn harvester, a plow, a chainsaw, or any other. Research using the Internet, books, and other sources. Explain how the tool has evolved.

3.0

Soil is an important resource that human activity can protect or degrade.

Key Concepts

In this section, you will learn about the following key concepts:

- fertilizers and soil nutrients
- resource management

Learning Outcomes

When you have completed this section, you will be able to:

- investigate and describe characteristics of soils
- identify practices that enhance and degrade soils

There is an important resource beneath this prairie.

Imagine you are out hiking across the prairie. All around you are grasses and wildflowers. Birds and insects buzz and chirp. As you walk along the trail, you think about the sun and the rain that makes all this possible. But would you remember the soil beneath it all?

Soil is a natural resource, like water and minerals. We depend on it to provide a healthy place for plants to grow. Many animals also live in the soil, from earthworms to prairie dogs. Think about the area where you live. What is the soil like? Do people affect the soil in any way?

3.1 What Is Soil?

When you think of soil, you probably think of brown dirt. You know that plants get nutrients and water from soil. You may even have noticed that soil can be very different in different places.

Think of some words that could be used to describe soil. Think about the colour and feel of different kinds of soil. How many words can you think of?

Figure 3.1 Soil has layers, each with different characteristics.

*info*BIT

Shifting Sands

The Sahara is getting larger every day. As the desert grows, the sand covers up fertile soil.

Give it a **TRY**

ACTIVITY

ALL SOILS ARE NOT CREATED EQUAL

Soils from different areas can have very different characteristics. Some soils are dry and can run through your fingers. Others are very wet and feel slippery.

Use three different types of soil: clay, loam, and sand. Filter 10 mL of water through 30 mL of soil. Collect and measure the water that comes through the filter for each soil. Record your observations in a table and draw a bar graph showing the results. (See Toolbox 7 if you need help with your graph.)

Which soil holds water best? Which soil is best for drainage? Which soil might be best to use when constructing earthen dams?

Figure 3.2

Figure 3.3

Figure 3.4

Problem Solving Activity

Designer Soil

Recognize a Need

Your family has just bought a new home. They have asked you to plant a vegetable garden. The soil is mostly clay and your first job will be to mix the clay with materials so that it is more like loam.

The Problem

How will you mix the materials available to you with clay soil to make it more like loam?

Criteria for Success

To be successful, your soil must

- form a moist, loose ball when squeezed
- show the characteristic of loam when you complete a drainage test similar to the one done in the Give it a Try on the previous page
- feel like moist cake

Sandy Soil

- runs freely
- moist soil will not form a ball when squeezed
- particles are mainly mineral
- does not hold water
- light brown

Clay Soil

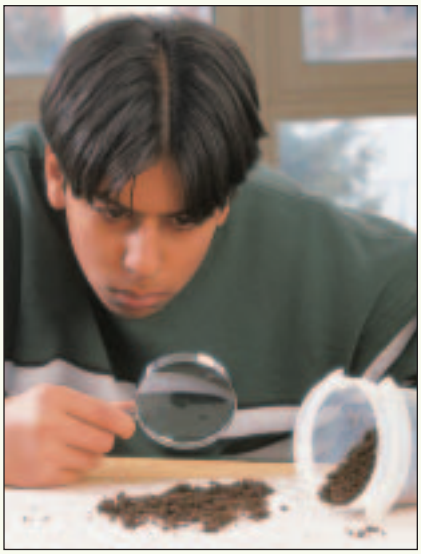
- feels sticky
- moist soil forms a tight ball when squeezed
- greater than 20% clay mineral particles
- holds a lot of water
- colour varies

Loam Soil

- feels like moist cake
- moist soil forms a loose ball when squeezed
- balance of organic and mineral particles
- holds some water
- dark brown to black

Brainstorm Ideas

1. Look at the available list of materials.
2. With a partner or on your own, decide what materials you will add to the clay. Also decide the amount of each material that you will use.
3. Decide how you will record your observations.



Make Your Soil

4. Using the available materials, create your new soil.

Test and Evaluate

5. Determine if your new soil is like loam soil. Use the soil characteristics that are listed in the margin.
6. Test your new soil for drainage using the technique from the Give it a Try on the previous page. If you didn't do this activity, your teacher will explain this test.
7. If you have access to a magnifying glass, look at the new soil under magnification and compare it with a magnified loam soil sample.

Communicate

8. Share your "recipe" for loam soil with your classmates.
9. What do the class mixtures have in common?
10. Which materials worked best to improve the drainage of clay soil?

Soil Contains Minerals and Organic Matter

Soil is not just dirt! When you look closely at soil, you see tiny particles with spaces between them. These spaces contain either air or water.

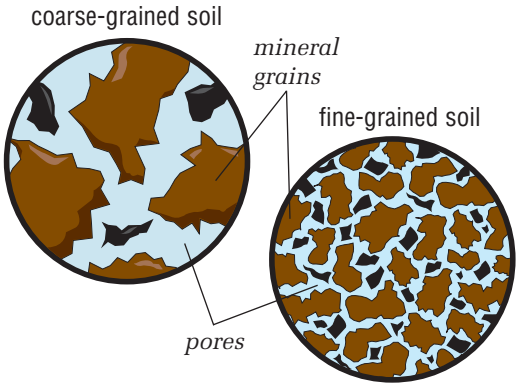


Figure 3.5 Soil is composed of different types and sizes of particles.

Soil has mineral and organic particles. The **mineral particles** are made from rock that has been broken down. Mineral particles make spaces in the soil that water can run through quickly.

The **organic particles** are made from plants and animals that were once living. When organic matter is partly decomposed, it is called **humus**. Humus provides plants with the nutrients they need. Humus also absorbs water.

Characteristics of Sandy Soil

Sandy soil runs between your fingers and has very few lumps. If you moisten sandy soil and squeeze it in your hand, the soil will not stay together. Sandy soil is light brown.

If you look at the particles of sandy soil with a hand lens, you will see that most of the particles are mineral particles and there is very little humus. Sandy soil therefore doesn't contain much food for plants. It also gets dry quickly, because water runs through it very fast.

Figure 3.6 The ingredients of soil

Characteristics of Clay Soil

Clay soil feels slippery when it is moist and you rub it between your fingers. If you squeeze wet clay in your hand, it will stick together and form a tight ball. Dry clay is very hard. The colour of clay soil is determined by the type of mineral particles that compose it. The colour can vary.

Clay soil has lots of mineral particles and little humus. Because the mineral particles are very small (0.0002 mm), clay soil has a fine texture. The pore size (spaces between the particles) is also small. Clay soil can hold water and nutrients but air cannot easily penetrate, especially when the pores are filled with water.

Characteristics of Loam Soil

Loam soil is crumbly, like a moist cake. If you squeeze wet loam in your hand, it will form a loose ball. It is not sticky. Loam soils are dark brown or black.

Loam soil has a balance between the amount of organic particles and mineral particles. It will absorb enough water to stay moist for a long time, but not so much that it will not have enough air in the spaces between the soil particles. Loam soil also has plenty of nutrients for plants to use. This soil is good for growing most plants.

RESEARCH

Vermiculite

Find out what the role of vermiculite is in potting soil, and how it is made.

Different Plants for Different Soils

Although you might think that loam soil is the best for all plants, there are some plants that would not grow very well in this type of soil. Remember that plants have adapted to their environment. If you put a plant that is adapted to clay soil in loam soil, for example, you might find that it isn't very healthy. Each plant will grow best in a different kind of soil.

Check and Reflect

1. What is soil made of?
2. Explain the importance of the spaces between particles in soil.
3. If you could choose the type of soil in your garden, what kind would you choose? Why?

TRY This at Home

Activity

How Does Your Garden Grow?

Many people change the type of soil they have in their gardens. They add things to the soil, or simply buy new soil altogether.

Has the soil been changed where you live? You can find out by looking at the type of soil in a flowerbed or vegetable patch, then comparing it with the soil in an area without a garden. This could be near a driveway or just under the lawn.

Discuss what you find with your class.

3.2 Our Practices Can Improve or Degrade Soil

Figure 3.7 The nutrients in this dead tree can be used by other organisms.

In a natural environment, nutrients are returned to the soil when plants and animals die and decompose. But when we harvest plants, we remove at least part of the plant and the nutrients in that part. Over time, the soil could be left with too few nutrients for plants to grow well.

*info*BIT

The Dirty Thirties

On the Canadian Prairies during the 1930s, drought and poor farming methods caused the topsoil to blow away.

Give it a **TRY** ACTIVITY

HUMAN ACTIVITY AND THE SOIL

Managing any living resource includes both costs and benefits to that resource. Soil is an important resource that must be managed to keep it healthy.

Copy the list below into your notebook. Beside each item, explain how the action described could help or harm the soil. Think about these carefully—some actions may harm or help, depending on how you do them.

- A farmer puts manure on his fields.
- A potato farmer irrigates her crop.
- The stubble that is left when a grain crop is harvested is plowed into the soil.

When you have finished, share your list with others in your class. Did you label all the situations the same? Discuss any situations that you did not agree on.

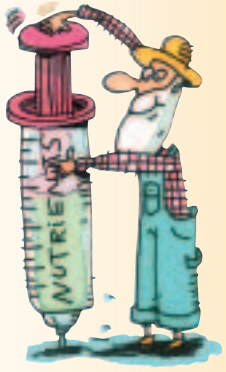


Figure 3.8 Soil helps this environment to stay healthy.

Soil Is an Important Natural Resource

We need soil to grow the plants we need for food and fibre. But soil is also important for other reasons. It supports the growth of wild plants that in turn feed and shelter animals. It also provides a home for a wide variety of soil-dwelling organisms.

Fertilizer Use

The soil nutrients that plants need can be provided by fertilizers. These are substances that are added to the soil. Organic fertilizers are made from sources such as animal or plant waste. Chemical fertilizers are mixtures of types of chemicals that promote plant growth. For example, potash is a chemical used in fertilizers to increase the potassium content of the soil. Urea and ammonia are both used as sources of nitrogen.

If the amount of fertilizer is not carefully measured, more nutrients may be added than the plant can use. This may harm the plant that the fertilizer was intended to help. Extra, unused nutrients may dissolve in rain or irrigation water and pollute the soil. The water in the soil can then carry them into streams, rivers, or lakes, causing pollution there as well.

Irrigation

Irrigation is widely used to grow plants in dry areas where there is too little rainfall overall or not enough at the right time of year. Irrigation helps farmers ensure that plants receive the right amount of water at the right time in their growth process. This can help to increase crop yields.

The use of irrigation requires careful management. If too much water is added to the soil, it will fill all the pores in the soil. With too little air in the soil, plants will not grow well.

Irrigation can also dissolve salts in the soil. In very dry areas, the evaporation of the water on the soil surface pulls the water and dissolved salts up to the surface. The topsoil may become too salty for plants to survive.

Clearing the Land

Before farmers plant new crops, they have to clear their land of plant cover. This makes it easier to plant seeds. It also reduces competition between their crop plants and other plants. Clearing farmland may involve removing most of the plant cover and plowing under any that remains. Or it could involve partial removal by leaving stubble on a field.

Foresters clear the land too. They will identify a desirable type of tree to harvest and establish tree age and size as part of the harvest criteria. As harvesting begins, those desirable species are removed, while other species are left to grow. After harvesting, foresters replant young trees to keep the forest sustainable.

If not carefully done, clearing land can expose soil to the weather. Without plant roots to hold it together, soil can be easily blown or washed away. Under a pounding rain, soil grains can squeeze together or compact, making it difficult for new plants to put down roots. The more plant cover that is left when land is cleared, the less soil erosion occurs. Plants also shade the soil, keeping it cool and moist.

Figure 3.9 The location, size, and shape of cut blocks can make a difference in the amount of soil erosion after trees are cut.

Decision Making Activity

Fertilizers and Soil

The Issue

Why are chemical and organic fertilizers both used? Which one is favoured in your community?

Background Information

All soil used for agriculture must have nutrients added to it, because the plants take nutrients out of the soil that are not returned. Some growers believe that using organic fertilizer, such as manure, is better for the soil. Other growers believe it is much better to use chemical fertilizers and will not use any organic fertilizers. The question of whether organic or chemical farming practices should be used can be a sensitive issue for particular communities and families. Here is a summary of the different ideas.

Figure 3.10 What kind of fertilizer should we use to keep this soil producing healthy plants?

Advantages of organic fertilizers	Disadvantages of organic fertilizers
• improves soil structure by adding large particles of humus • provides a source of food for useful soil organisms • recycles animal waste • is unlikely to add excess nutrients to the soil • releases the nutrients slowly	• some types have a low nutrient content • each batch may have a different nutrient content • it can contain disease organisms that can infect plants, livestock, or humans • it can contain weed seeds • it is difficult to spread evenly

Advantages of chemical fertilizers	Disadvantages of chemical fertilizers
• you know the exact amount of each nutrient you are adding • you can match the amount of each nutrient you add to what your soil needs • it is easy to apply evenly on the soil • it does not bring in any disease organisms or weed seeds	• does not improve soil structure • releases nutrients quickly and can be too concentrated • can easily add more nutrients to the soil than the plants can use • can hurt useful soil organisms • can contaminate the groundwater, lakes, and streams with too many nutrients

Support Your Opinion

Decide for yourself if organic fertilizer is better to use than chemical fertilizer. Write a paragraph defending your views. Include your prediction of the effect of long-term use of both chemical and organic fertilizer.

Plowing Changes Soil

Plowing is the process of cutting into the soil and turning the top layer over. Plowing breaks up the soil, creating more air spaces and making it less compacted. Over time, plowing can damage the soil because it makes the soil particles smaller, and so the soil can become waterlogged and compacted more easily.

New equipment has been designed that will cause less damage. In the 1930s, farmers recognized that "trash cover" (stubble and other plant material) protected the soil from wind erosion. To benefit from the use of "trash cover," the farmers in southern Alberta needed a blade cultivator that would go under the stubble and kill the weed. In 1936, C.S. Noble from Nobleford, Alberta, developed a blade that replaced traditional plows. This blade cut below the ground while leaving the top of the ground with its stubble intact. Today, the Noble Blade and Drill is used around the world.

Figure 3.11 The Noble Blade and Drill

Crop Rotation Helps to Keep Soil Healthy

What do you think would happen to a soil if you grew the same crop year after year? If you answered that the soil would run out of the nutrients that the crop plant needs, you would be right. To keep growing that crop, you would have to add lots of fertilizer every year. Fertilizer is expensive, and the soil might also be polluted by the nutrients that the plants don't use.

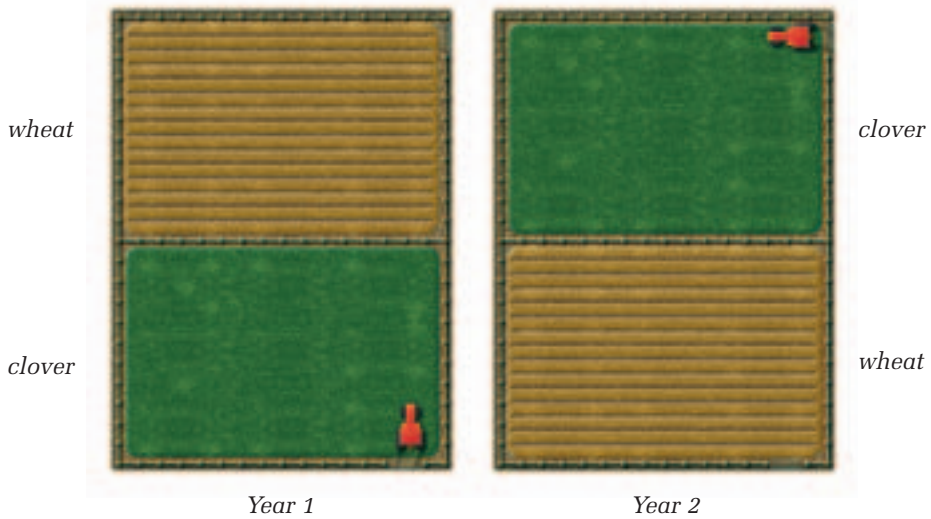


Figure 3.12 Planting more than one kind of crop can reduce the use of fertilizer.

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No-Till Farming

Crop scientists have developed a new method of growing crops that doesn't involve plowing. Find out about the advantages and disadvantages of no-till farming. You might want to start your search on the Internet.

Crop rotation is the practice of planting a different crop in a particular field every year. The kinds of plant that are rotated must be matched according to their nutrient needs. For example, if one plant uses a lot of phosphorus and very little nitrogen, it could be matched with a plant that uses very little phosphorus and a lot of nitrogen.

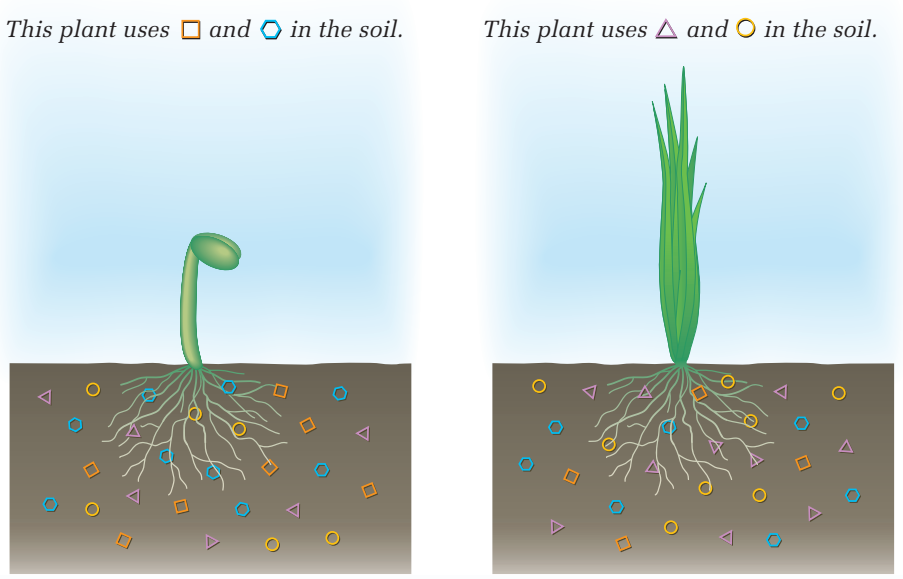

Figure 3.13 During crop rotation, one plant uses the nutrients that the other doesn't need.

Check and Reflect

1. Indicate which of the following statements are true, and which are false. Correct each false statement to make it true.
   a) Soil is only important to farmers.
   b) Using lots of fertilizer to grow plants is always helpful.
   c) Plants can help prevent wind erosion.
2. Describe an Albertan contribution to decreasing the impact a plow makes on soil.
3. Write a poem, paragraph, or story expressing how you feel about taking care of soil.

Assess Your Learning

1. Describe clay soil.
2. Give two characteristics you could use to identify loam soil.
3. Below are two examples of preparing the soil by plowing. Explain one advantage and one disadvantage for each method.

Figure 3.14 Plowing bare soil

Figure 3.15 Plowing plant material under

4. A farmer plants the same crop in the same field every year. How will this affect the soil?

Focus On Science and Technology

In this section, you found out that some of the practices we use to help plants to grow can harm the soil. Consider the following questions.

1. What changes have been made in technology to reduce the damage to soil?
2. Over the past 100 years, humans have used the soil for a variety of purposes. How does human use impact the soil now compared with 100 years ago?

4.0

The ways that plants are grown and used are related to human needs, technology, and the environment.

Key Concepts

In this section, you will learn about the following key concepts:

- plant varieties
- selective breeding
- monocultures
- resource management
- sustainability
- chemical and biological controls

Learning Outcomes

When you have completed this section, you will be able to:

- describe how plant varieties are developed
- investigate consequences of how we manage the environment
- identify intended and unintended consequences of environmental management
- evaluate the effect of different practices on sustainability of resources
- describe the consequences of using herbicides, pesticides, and biological controls
- identify practical problems and issues in producing plants in a sustainable way

Have you ever played the game Jenga? In this game, you keep pulling pieces out of the bottom and putting them on the top. You can probably see that eventually, the whole thing will come crashing down.

Some of the things we do to grow and harvest plants are like pulling the pieces from the bottom of the Jenga game. If we keep on in the same way, eventually we will make our environment collapse. What do you think would happen if we kept logging our forests and didn't plant any more trees?