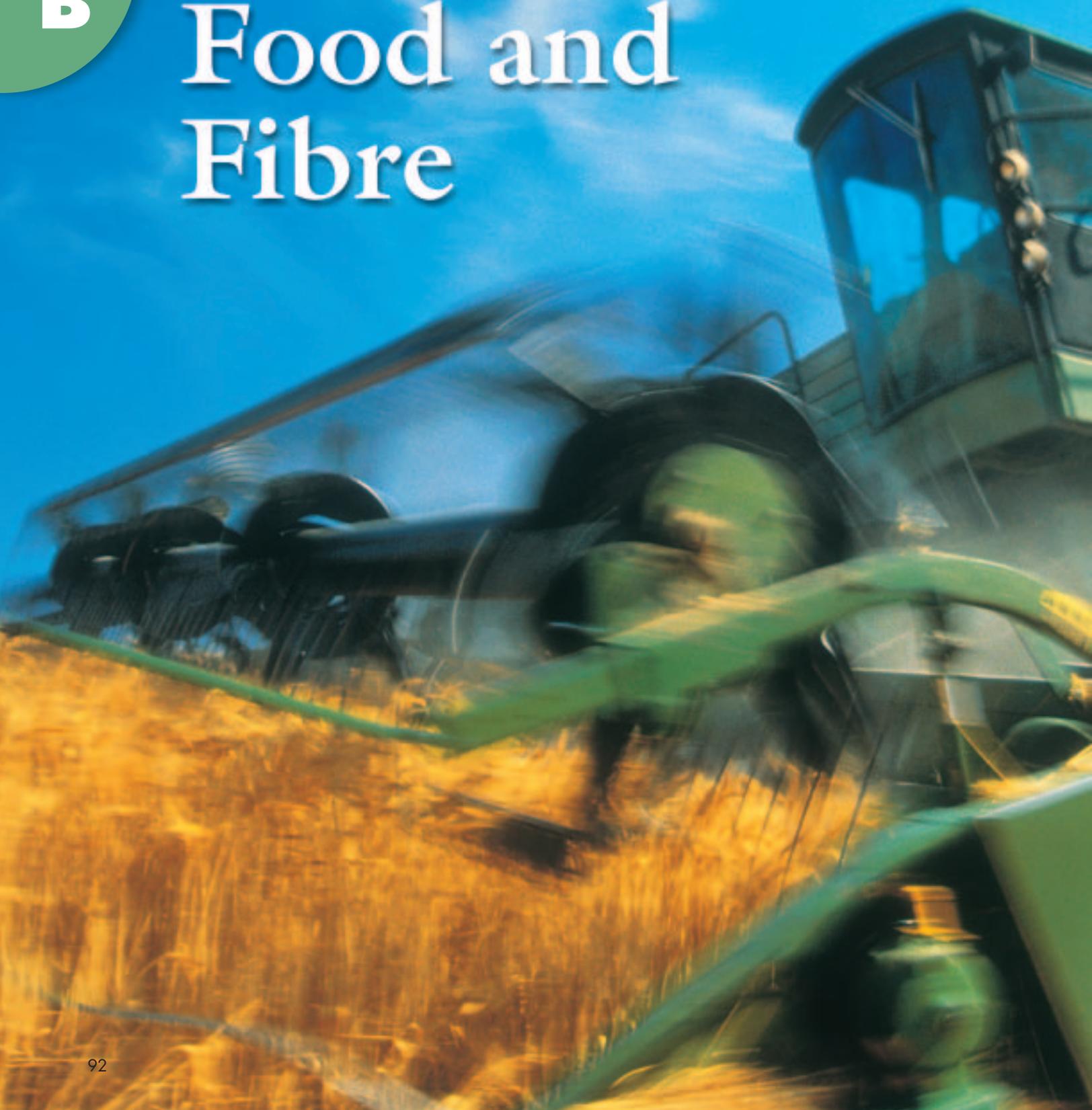


UNIT

**B**

# Plants for Food and Fibre





**In this unit, you will cover the following sections:**

**1.0**

**Understanding structures and life processes of plants helps us to interpret their needs.**

- 1.1 The Body of Seed Plants
- 1.2 Plant Processes
- 1.3 Reproduction of Seed Plants
- 1.4 Plant Structures Vary to Adapt to Their Environment
- 1.5 Plant Needs and Growing Conditions

**2.0**

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

- 2.1 The Role of Plants in the Environment
- 2.2 We Use Plants in Many Ways
- 2.3 Natural and Managed Resources

**3.0**

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

- 3.1 What Is Soil?
- 3.2 Our Practices Can Improve or Degrade Soil

**4.0**

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

- 4.1 Modifying Environments to Increase Yields
- 4.2 New Plant Varieties Are Developed by Selective Breeding
- 4.3 Controlling Weeds and Pests
- 4.4 Consequences of Environmental Management

# Exploring



Our planet would be a very different place without plants. In this unit, you will find out why plants are critical for all life on Earth. You will learn about the many ways we use plants, and the technologies we use to produce the plants we need. You will investigate how plants have adapted to different environmental conditions. You will take part in activities that will challenge you to come up with real-life solutions to problems that can be caused by the ways we grow plants. Understanding the consequences of the changes we make in growing plants will allow you to predict when these changes can harm the environment.

## SURVIVING IN THE WILDERNESS

Many great stories have been written about people who have found themselves stranded and alone in a wild place. *Robinson Crusoe*, by Daniel Defoe, is one such story about a man who is shipwrecked on a deserted island and has to survive on what he can make or find.

Do you think you could survive in a wild place? The teenagers in this newspaper article found out the hard way that they could survive in the wilderness of northern Alberta!

### Teens Found Alive in Bush



*Rescuers airlift survivors to safety.*

Elk Point, Alberta. – Wild berries and boiled leaves and roots kept three teens alive during a 24-day ordeal on a remote island on Frog Lake, 210 km northeast of Edmonton. The teens became stranded after the paddleboat they used to get to the island drifted away from the shoreline. The trio was unable to swim off the island,

since the shoreline was an icy 300 m away.

The quick-thinking teens set to work searching for food and shelter. They made a lean-to and bedding out of pine boughs. They collected edible berries, roots, and leaves. The teens also collected twigs for firewood and were able to light a fire with a cigarette lighter.

The teens ate rose hips and slept on boughs.



### **Safety Caution!**

Never eat any plant that you find in the wild unless you are sure what it is.

Many plants can make you sick.

These young people were able to survive because they used plants for food, shelter, and warmth. The photographs above show two examples of plants that they used.

Our provincial flower, the wild rose, has many parts you can eat. The hips in particular can be an important survival food, since they are available throughout the fall and winter. One rose hip can contain as much vitamin C as an entire orange, as well as other important nutrients.

Balsam fir has soft needles that can provide wonderful bedding. The resin from this tree can also be used to relieve insect bites, sores, or rashes.

How about you? Would you know how to use plants to help you survive? With a partner, see if you can name two plants that you could use. At least one of them should be a plant you can eat.

## **Give it a TRY**

### **A C T I V I T Y**

#### **SURVIVOR!**

You and your friends love to spend the weekend camping in the great outdoors. But while you are hiking in the woods, you take a wrong turn and can't find your way back. You're lost!

You might have to stay in the woods for a few days until someone finds you. All you have is the clothes you are wearing, a pocketknife, and anything you can find in the woods.

In a small group, discuss how you could use plants that grow in the woods in your area to meet your basic needs of food, warmth, and shelter. How long do you think you could survive?



As you proceed through this unit, you will be asked to organize your thoughts around how technology can help us to grow and use plants in a way that doesn't harm the environment. Many human activities are a balance between these two things. You will be asked to think about these ideas as you perform activities and answer questions throughout this unit.

1. **How is the environment affected by the way we produce and harvest plants?**
2. **What technologies can help us to produce the plants we need and also minimize the impact we have on the environment?**
3. **What kind of knowledge must we have about plants and their environment to ensure we continue to produce the plants we need and keep our planet healthy?**

The answers to these and other questions about plants will help you understand how using plants for our needs relies on knowledge and the use of appropriate methods. The project at the end of the unit is a chance to apply what you have learned by designing and building a growth chamber for vegetable seedlings.



# 1.0

## Understanding structures and life processes of plants helps us to interpret their needs.

### Key Concepts

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

- life processes and structure of plants
- plant propagation and reproduction

### Learning Outcomes

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

- describe the parts of a seed plant
- explain the processes that a plant uses to stay alive
- describe the life cycle of seed plants



Do you know what a plant needs to live?

You probably know a lot about plants. You might know that most plants have leaves, at least one stem, and roots. And lots of plants have flowers. But of course, not all plants are the same. Think how different a cactus is from a pine tree! Do you believe that they both have the same parts? It's true!

Is there anything that you've ever wondered about plants? There are so many questions we could ask. Why do they produce flowers? How does a seed work? Let's take a closer look at plants and see if we can find answers to some of these questions.

# 1.1 The Body of Seed Plants

In this unit, we are going to look only at those plants that make seeds, or **seed plants**. Some examples of seed plants that you might have seen are daisies, cottonwood trees, wheat, and orchids. As you see, seed plants come in all shapes and sizes.

On a clean page in your notebook, sketch a seed plant. It can be any kind of seed plant you want. Label each part, then write down everything you know about the part in point form beside each label. As you work through this unit, you can look back to your sketch and your notes and add or change anything you want to as you go along.

## infoBIT

### The Same, but Different



Although they look very different, the structures that make up these plants are the same. What are these structures?



**Figure 1.1** Seed plants are the largest group of plants in the world.

## Give it a TRY

## A C T I V I T Y

### PLANT PART CHARADES

Do you think you could describe the parts of a seed plant without speaking out loud? Try it and see!

Your teacher will hand you a card that will have one of these plant parts written on it: stem, leaf, root, or flower. When you get your card, read what's on it and think about how you might act out your word.

Pick a partner and take turns acting out your words. After you get the correct word, discuss the function of the plant part with your partner.



# Problem Solving

## Activity

### Materials

- a collection of craft materials that could be used to make a model, such as construction paper, cardboard, tissue paper, pipe cleaners, craft sticks, modelling clay

## DESIGN A MODEL OF A SEED PLANT

### Recognize a Need

You own a small company that makes displays for museums and science centres. One of your clients needs a model of the structures found in a seed plant. The model has to be simple enough for small children to understand, but it has to be accurate.

### The Problem

Make a three-dimensional model of a seed plant.

### Criteria for Success

For your model to be considered successful, it must

- contain all the parts of a seed plant
- have labels on all the parts

### Brainstorm Ideas

- 1 With a partner, make a list of all the parts that must be included on your model.
- 2 Draw a sketch of how your finished model will look.
- 3 Make a list of the materials you might use to create your model.

### Build Your Model

- 4 Gather your materials and construct your model.

### Test and Evaluate

- 5 Look over your model and check how well it fits the criteria for success. Make any changes to your model that you think are needed.
- 6 Set your plant model up in an area designated by your teacher. Look over other students' models and compare them with your design. Assess how well the other models fit the criteria. Are all the models the same or different? Suggest a reason to explain this.

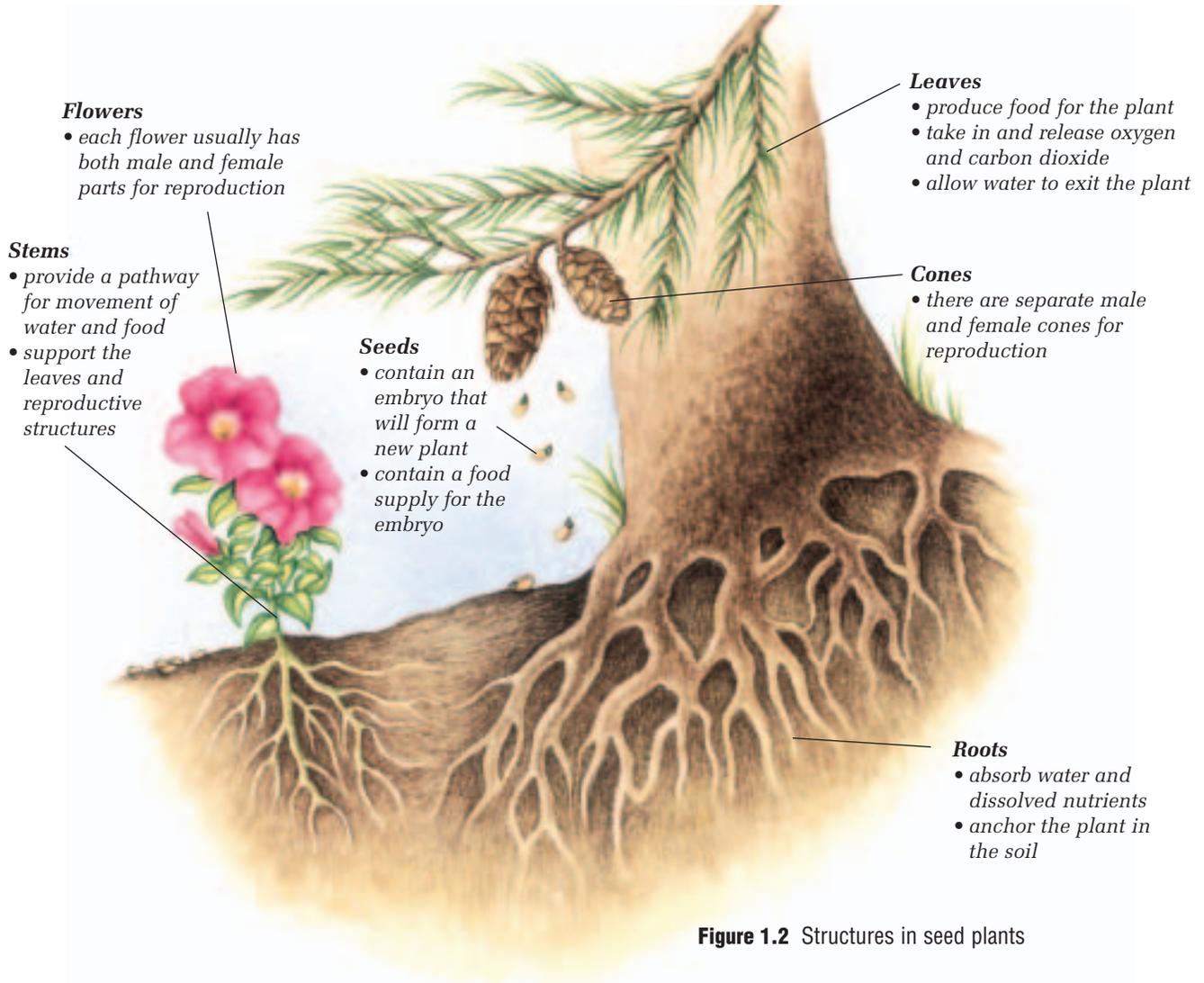
### Communicate

- 7 With your partner, write a description of each of the plant parts that are on your model. Your description should be in a style that would suit a science centre display.



## EACH PLANT STRUCTURE HAS A FUNCTION

Seed plants not only have the same kinds of structures, but these structures do the same job in all plants.



### CHECK AND REFLECT

1. What are the main parts of a seed plant?
2. Draw a diagram of a root or a leaf. Write two or three sentences below your diagram that describe the function of the structure you choose.
3. Why do plants produce seeds? Name one plant structure that can produce seeds.
4. Give three examples of seed plants that grow in your area. Do not use any of the examples from this book.

**Water Me!**



More than 90% of the water a plant takes in is lost through its leaves. No wonder they need to be watered regularly!

## 1.2 Plant Processes

This tall tree has to move water up from its roots and food down from its leaves. How do plants transport these substances?

You have probably broken or cut a plant apart, so you will know that plants don't have a heart or a pump to move water and nutrients around. Discuss with a partner how a plant might move substances from one part to another. Have you seen any other examples of fluids moving without being pumped?



**Figure 1.3** Do plants have a pump?

### Give it a **TRY**

### A C T I V I T Y

#### MOVING IN THE RIGHT DIRECTION

Plants can move water from the soil up to their leaves. Animals move fluids around their bodies by the pumping action of their hearts. This experiment can help you understand how plants move fluids.

Put enough water in each beaker so that they are both about one-third full. Mix several drops of food colouring into the water.

Remove the leaves from one stalk of celery. Prop the celery in the beaker so its base is in the water. Place the other stalk that still has its leaves in the other beaker.

Place both beakers containing the celery stalks under a bright light or in a sunny spot for about three hours.

Remove the stalks from the water and cut cross sections from each stalk at several places so you can see how far the food colouring moved up the stalk.

Compare the distance the food colouring moved up in the two stalks. Why do you think this difference occurred?

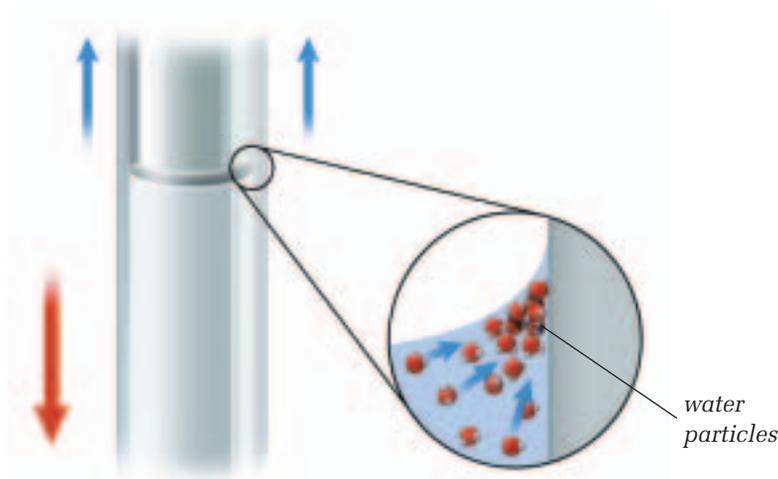
#### **Materials & Equipment**

- water
- food colouring
- 2 400-mL beakers
- 2 stalks of celery with leaves
- small sharp knife or razor blade

## A PROCESS FOR MOVING WATER UP FROM THE ROOTS

Water moves up a plant from the roots to the leaves by a combination of processes. These processes include the following:

- The main process that draws water up from a plant's roots is **transpiration**. Transpiration is the evaporation of water from the surface of the plant—mainly from the leaves. Water particles evaporate from the surface of the leaves, and more water particles move up within the plant to take their place. This process continues down through the plant with particles continually moving up from the roots.
- Another process that helps water move up through a plant is called **capillary action**. Water travels from the roots to the leaves through tiny tubes in the roots and stems. You may have learned in other lessons that water particles are attracted to one another. This attraction causes water particles to “stick” to one another. The water particles are also attracted to the sides of the tiny tubes. This attraction, along with the attraction between the water particles themselves, helps to move the water up inside the plant.
- Water from the soil enters root cells by a process called **osmosis**. When the concentration of water in the soil is greater than the concentration of water in the roots of the plant, water moves into the root cells. You will learn more about osmosis in this subsection.



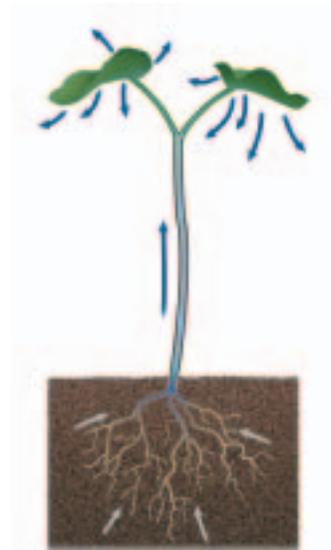
**Figure 1.4** When tubes are very narrow, like this glass tube, the force of the attraction of the water particles to the sides of the tube is greater than the force of gravity, so the water moves up.

**Figure 1.5** Water moves into root cells and then travels up tiny tubes to the leaves. Water particles exit through small holes in the leaves. If there is too little water in the soil, and the plant continues to lose water from its leaves, the plant wilts.

## SEARCH

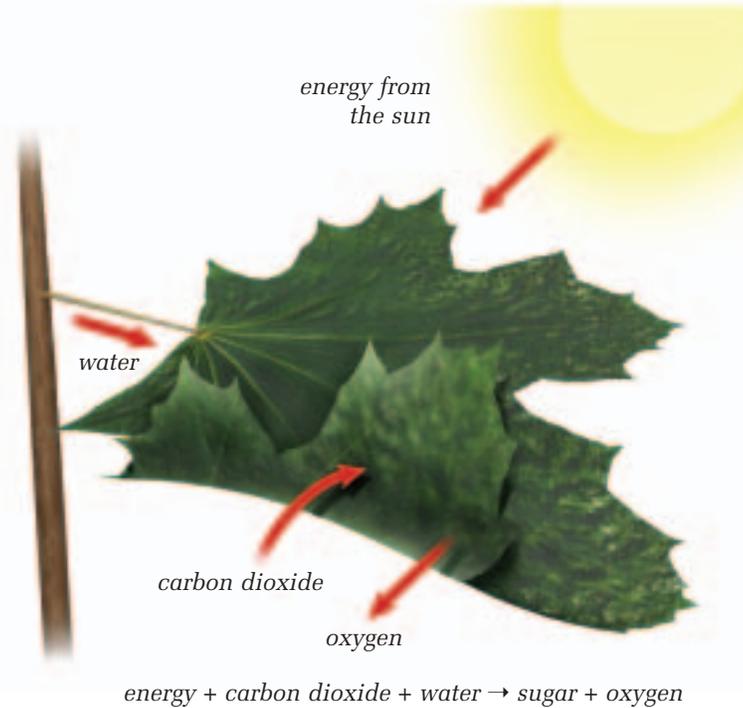
### Moving Up

Place a plastic bag over a plant and tie it shut. Leave it in a sunny window for a day. Explain what happens using the word “transpiration.”



## A PROCESS TO MAKE FOOD

Plants make their own food by the process of **photosynthesis**. Photosynthesis produces a type of sugar.



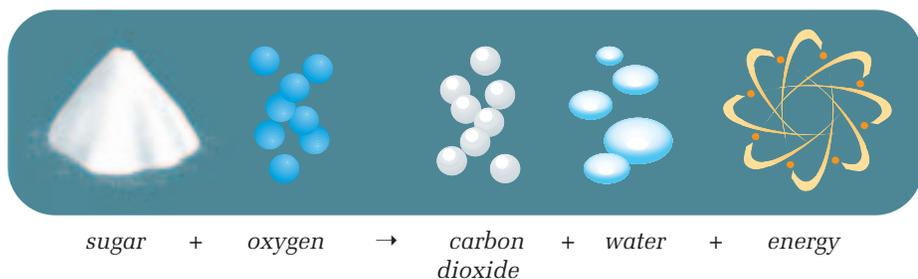
**Figure 1.6** Plants use the energy from the sun to make their own food.

The leaves of seed plants usually do most of the photosynthesis. Photosynthesis takes place in structures inside the leaves called **chloroplasts**. The chloroplasts capture the sun's energy and use it to join carbon dioxide and water together to make sugar. This process also produces oxygen.

## A PROCESS TO USE FOOD

When plants photosynthesize, they use energy to turn carbon dioxide and water into sugar. When plants use this sugar for food, they get energy and produce carbon dioxide and water as waste. This process is called **cellular respiration**.

**Figure 1.7** The word equation for cellular respiration.



### Materials & Equipment

- 2 plant cuttings wrapped in moist towelling
- graph paper
- 2 small beakers or clear vials
- 10-mL or 25-mL graduated cylinder
- water
- plastic wrap
- scissors
- a sunny window

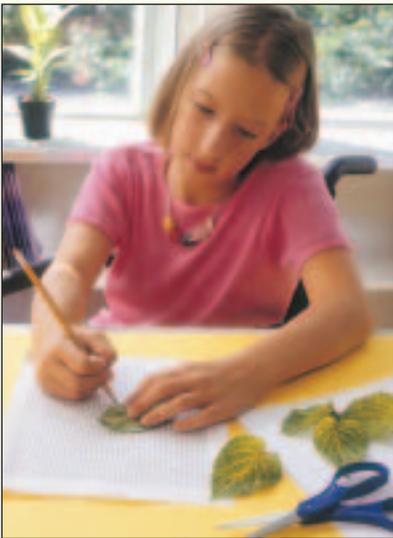


Figure 1.8 Step 7

### The Question

How does transpiration move fluids from the roots?

### The Hypothesis

If evaporation occurs from the surface of the plant, then fluids move up from the roots into the stems and leaves.

### Procedure

- 1 Collect two plant cuttings that are about the same size. Carefully remove all the leaves but one from one cutting. Keep all the leaves on the other.
- 2 Determine the volume of water that will fill the beaker to about 1 cm from the top. Measure the same volume of water and fill each of two beakers.
- 3 Stretch a sheet of plastic wrap tightly over the top of each beaker. Using a pencil, punch a hole in the plastic.
- 4 Cut about 0.5 cm off the bottom of each plant cutting. Place the stem of the cutting in each beaker of water through the hole in the plastic.
- 5 Put your cuttings in a sunny window and leave them overnight.
- 6 The next day, remove each cutting from its container. Be careful not to lose any of the water. Using the graduated cylinder, measure the amount of water that is left in each of the beakers. Record your findings.

### Collecting Data

- 7 Remove the leaves from one cutting. Carefully trace the outline of each leaf on a piece of graph paper.
- 8 Estimate the area of each leaf by counting the number of squares it fills. Count any square that is at least half inside the outline.
- 9 Estimate the area of all the leaves and record your findings. You may want to make a table or use a spreadsheet program.

### Analyzing and Interpreting

- 10 Make a bar graph showing the amount of water that was in the two beakers on the second day. Make a second bar graph that shows the total leaf area of the two cuttings.

### Forming Conclusions

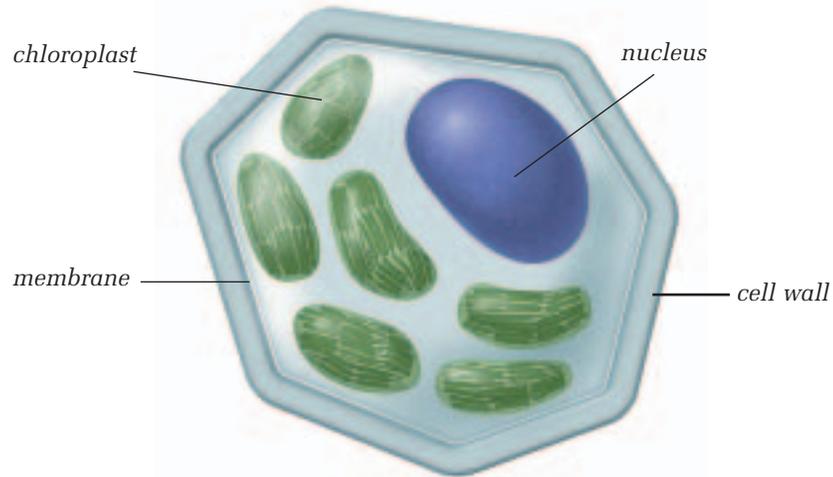
- 11 Which of the cuttings lost more water? Compare the leaf area of this cutting with the other.
- 12 Water evaporates from pores on leaves. What do you think happens to the rate of evaporation if there are fewer leaves on a plant?

### Applying and Connecting

Have you ever forgotten to water your house plants, and found that they wilted? Suggest a reason why this happens.

## PROCESSES TO MOVE SUBSTANCES IN AND OUT OF PLANT CELLS

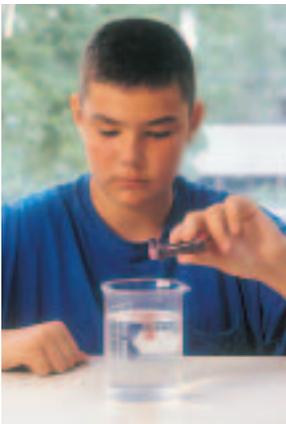
After a plant has made sugar in its leaves by photosynthesis, it must transport this food throughout its body. It also has to move the water out of the stem into the rest of its cells.



**Figure 1.9** Under the cell wall in the plant cell is a cell membrane that has tiny openings. The size of these openings controls what particles can pass through. Particles of water and certain other substances can get in and out of the cell.

### math Link

If you stirred 3 g of sugar into 9.3 mL of water, how many grams of sugar would be in each millilitre of water?



**Figure 1.10** The food dye slowly mixes with the water due to diffusion.

As shown in Figure 1.9, the plant cell is surrounded by a membrane that has **pores**, or tiny openings. Particles of some substances are able to move in and out of a cell through these pores. The cell membrane acts as a filter, keeping some substances inside the cell and allowing some substances to move in and out of the cell. Many processes take place to move substances in and out of plant cells. One of these processes is **diffusion**. Diffusion takes place when there is a difference between the **concentration** of a substance inside and outside a cell. Another process that does not require a difference in substance concentration is called **active transport**. Active transport uses energy to move substances in and out of plant cells.

### Diffusion

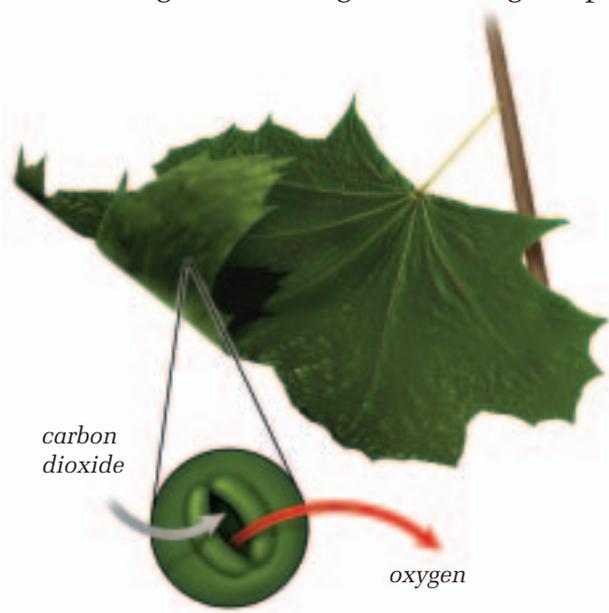
When you put a drop of food dye in a glass of water, you get one small area with a lot of dye particles and a large area with none. In other words, there is a higher concentration of dye particles in the drop of food dye. Concentration is the number of particles of one substance in a certain volume of another substance. Diffusion is the movement of particles from an area of high concentration to an area of low concentration, until there is an equal number of particles everywhere. Particles that are small enough to fit through the membrane pores in a plant cell move in and out of the cell by diffusion.

## Osmosis

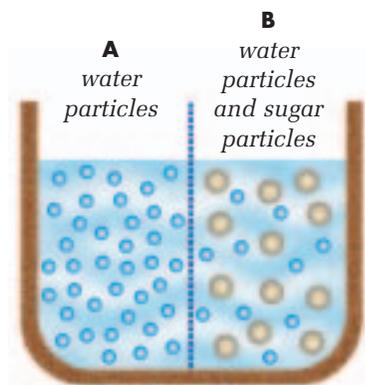
Water is one of the substances that is vital to the survival and health of cells. The cell membrane in plant cells allows water particles to pass through. If the water concentration inside a cell is lower than the water concentration outside, water particles from outside move in through the cell membrane. If the water concentration inside the cell is higher than outside, the cell loses water to the outside. **Osmosis** is a special name given to the movement of water particles through a membrane. Osmosis moves water particles from a cell with a high water concentration to a cell with a low water concentration. Water usually moves out of the cells in the stem to the rest of the plant cells.

## A PROCESS TO EXCHANGE GASES

In the process of photosynthesis, plants use carbon dioxide gas and produce oxygen gas. In the process of cellular respiration, plants use oxygen and produce carbon dioxide. **Gas exchange** is the process of these gases entering and leaving the plant.



**Figure 1.12** Oxygen and carbon dioxide diffuse through tiny openings in the leaf.



**Figure 1.11** This membrane has pores that allow the water particles to pass through but not the sugar particles. The concentration of water particles is higher in side A than in side B, and water particles move from A to B through the membrane. This movement of water is called osmosis.

## CHECK AND REFLECT

1. What raw materials does a plant require for photosynthesis? What are the products?
2. How are osmosis and diffusion related?
3. Describe three processes that allow water to move from roots to leaves.
4. What do you think would happen to transpiration if a plant were blowing in a hot, dry wind?

# Experiment

ON YOUR OWN

## LIGHT AND PLANT GROWTH

### Before You Start ...

Plants use light to photosynthesize and produce the food they need to grow. Farmers will sometimes clear their fields just to make sure that their crops get as much light as possible.

In this activity, you will design an experiment to test whether plants grow faster when they get more light.

### The Question

Do plants grow faster when they get more light?

### Design and Conduct Your Experiment

You may wish to use Toolbox 2: The Inquiry Process of Science to help you plan your experiment.

- 1 Make a hypothesis that will allow you to test the effect of different amounts of light on the growth rate of plants. (A hypothesis is a possible answer to a question or a possible explanation of a situation.)
- 2 Decide what materials you'll need to test your hypothesis. For example:
  - a) What kind of plants will you use?
  - b) How many plants will you need?
  - c) Will you grow the plants from seed or buy plants?
  - d) What will you use to supply the light?
- 3 Plan your procedure. Ask yourself questions such as:
  - a) What evidence am I looking for to support my hypothesis?
  - b) What steps will I follow to collect the data I need?

- c) Is the test I've designed fair? How do I know?
  - d) How will I record my results? For example, do I need a data chart? a graph? both? neither?
  - e) How long do I have to complete my experiment?
- 4 Write up your procedure. Be sure to show it to your teacher before going further.
  - 5 Carry out your experiment.
  - 6 Compare your results with your hypothesis. Did your results support it? If not, what possible reasons might there be?
  - 7 Share and compare your experimental plan and findings with your classmates. Did anyone plan an experiment exactly like yours? similar to yours? How do your results compare with theirs?



**Figure 1.13** How will you change the amount of light?

# 1.3 Reproduction of Seed Plants



**Figure 1.14** These wheat seeds are about to begin their life cycle.

A farmer plants wheat seed in the spring and waits for the first shoots of the crop to appear. In a few weeks, the shoots begin to grow tall and green, and leaves may begin to sprout. By the end of the season, the field is covered with healthy plants that have rows of seeds on their stems.

When the wheat is ready to harvest, the wheat plants have gone through an entire life cycle. A **life cycle** is the stages that a living thing passes through to go from one generation to the next. For seed plants, the life cycle starts when a seed begins to grow into a plant and ends when that plant produces seeds of its own.

Think about crops grown in your area. Have they gone through all the stages in their life cycle when they are ready to harvest?

## infoBIT

### Packaging Palms



This coconut will eventually grow into a tall palm tree.

## Give it a TRY

## A C T I V I T Y

### THE SECRET OF SEEDS

You are going to look inside some different types of seeds. To make them easier to open, they have been soaked in water beforehand.

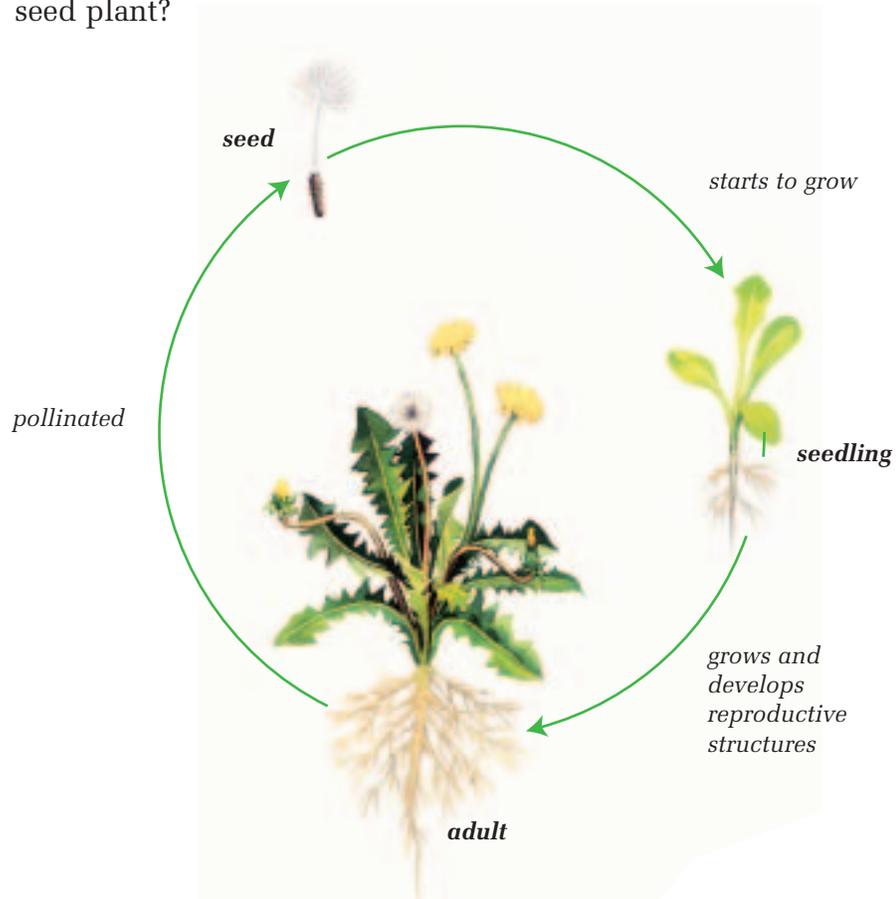
- Pick up one of each type of seed.
- Open each seed by splitting it carefully in half. Examine the inside.
- Make a diagram of the structures you see inside each seed. Label any parts you recognize.

Were all the seeds the same inside? From what you saw, can you explain what happens when a seed starts to sprout?



## THE LIFE CYCLE OF SEED PLANTS

The stages in a life cycle are often drawn as connecting points on a circle. Look at Figure 1.15. What are the stages in the life cycle of a seed plant?



**Figure 1.15** Seed plants have three stages in their life cycle.



**Figure 1.16** Seeds contain enough food to start the new plant growing.



**Figure 1.17** The seedling needs plenty of sunlight, nutrients, and water to grow.



**Figure 1.18** This plant is an adult because it has flowers.

### The Seed Stage

A seed has three main parts: the embryo, stored food, and a seed coat. The stored food surrounds the embryo in some plant species. In other species, food is stored in part of the embryo itself. The embryo uses this stored food to survive until it begins to photosynthesize and produce its own food.

### The Seedling Stage

Plants in the seedling stage grow very fast and produce new leaves, roots, and stems. Seedling plants produce their own food by photosynthesis, but they also need nutrients from the soil to build their new parts.

### The Adult Stage

A plant is an adult when it produces reproductive structures. For seed plants, these structures are either a flower or a cone.

## REPRODUCTION OF SEED PLANTS

### Pollination

Plants produce flowers and cones only so they can make seeds. To do this, the adult seed plant needs to undergo the process of **pollination**.

The diagram in Figure 1.19 shows the parts of a flower. The male part of the flower that is involved in pollination is called **pollen**. Pollen grains are small, sticky cells. One plant produces millions of pollen grains.

The female part of the flower is called the **ovary** and is usually in the centre of the blossom. The ovary contains the **ovule**. Pollination occurs after a pollen grain lands on the *stigma* of the flower, above the ovary (see Figure 1.19). The pollen grain produces a pollen tube that grows down from the stigma to the ovule. Through this tube, cells transfer from the pollen grain to the ovule. The ovule then grows into a seed.

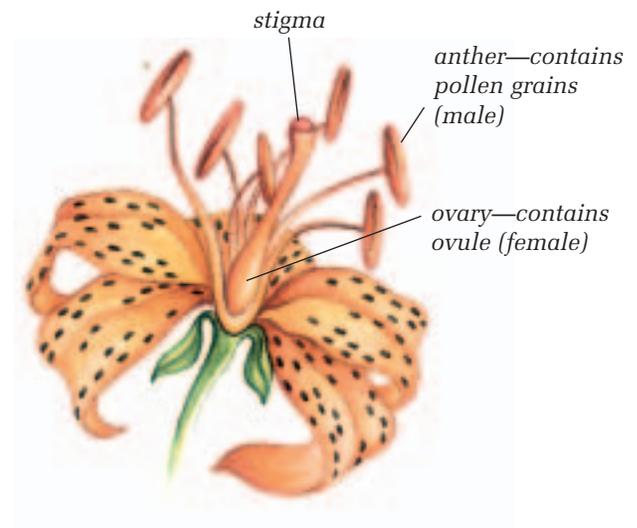
Plants that produce cones (called conifers) usually have separate male and female cones. The male cones produce pollen, and the female cones contain the ovules. When the ovules are pollinated, seeds develop on the female cones.

### Pollinators

Plants need a way to get the pollen to the ovules. Some plants release pollen in the air, where it is carried by the wind. Conifer trees and grain crops are pollinated by wind.

Many flowering plants rely on **pollinators**, which are organisms that carry pollen from one flower to another. Birds, insects, and even bats can be pollinators. Pollinators come to a flower in search of nectar, a sugary liquid that they eat. As the animal enters the flower, it becomes coated in pollen. When it leaves, it takes this pollen with it and transports it to the next flower.

Many of our crops such as grains and fruits must be pollinated. Growers have found ways to ensure that pollination takes place. Many plants, such as corn, are grown in rows a particular distance apart to help them be pollinated by the wind. Fruit growers will often keep beehives near their plants.



**Figure 1.19** Flowers usually have both male and female parts.



**Figure 1.20** Many plants are pollinated by insects.

## GERMINATION AND GROWTH

### Recognize a Need

Space is scarce in the greenhouse where you and your colleagues work as research technicians. Improvements in the method for growing plants are required. There are three possible ideas under consideration. Your group will have one or more people investigate each idea. Once you are done, you can compare your results and determine the best method for growing seedlings in the greenhouse.

### The Problem

One idea is to use plastic bags with moist inserts as a method for starting and studying seed growth. These bags can be attached to the wall and therefore will not require table or floor space.

The second idea is to use different packing densities for seedling growth. If you can pack more seedlings into a smaller space, there will be more available table and floor space.

The third idea involves determining the best treatment of seeds to prevent moulding. Because of the space problem, the treated seeds will be germinated in small plastic bags and tacked to the wall.

### Criteria for Success

For this activity to be considered successful, you must

- decide as a group who will investigate each idea
- complete your investigation and collect appropriate data
- compare results and determine the best method for growing seedlings in the greenhouse

### Brainstorm Ideas

- 1 Below are the task requirements and materials needed to investigate each idea. Read all of these so you are aware of what your partners are doing.
- 2 As a group discuss a plan for each idea using the materials available.
- 3 As a group decide how you will use the same process to measure and record plant growth.
- 4 Prepare a plan for the idea you are investigating. Have your teacher approve your plan before carrying it out.

### Materials & Equipment

- bean and corn seeds
- small plastic bags
- absorbent material such as paper towel, cotton batting, coffee filters, vermiculite

### Idea 1 – Using Plastic Bags

#### Task 1

To germinate (grow) seeds in a way that allows seedlings to be easily observed and transplanted to soil.

## Idea 2 – Using Different Packing Densities

### Task 2

To determine how many seeds can be planted in a confined space without adversely affecting their growth. Your plan should include growing different numbers of seeds (from 2 to 20) in the confined space of a small plastic bag or a 7-cm pot.

## Idea 3 – Preventing the Formation of Mould

### Task 3

To develop a process that prevents or reduces mould growing on seeds. Prepare a plan that will enable you to determine if briefly soaking seeds in vinegar or a baking soda solution is able to prevent mould from growing on the seeds during germination. Plastic bags with moistened inserts will be used to germinate the seeds.

### Test and Evaluate

- 5 With permission from your teacher, carry out your plan in a safe manner.
- 6 Record your observations and data.
- 7 If possible, prepare a graph from your data.

### Communicate

- 8 Work as a group to produce a report. The first section should be your recommended solution. Use data collected in your investigation to support your recommendation. The second section should be three individual summaries describing the work done by each group. For your summary, include observations and a graph if you were able to make one. How does your investigation solve the problem? Discuss any changes you would make to your investigation if you were to repeat it.

### Materials & Equipment

#### Idea 2

- seeds such as corn, beans, radish, or lettuce
- plastic bags or 7-cm pots
- absorbent materials such as paper towel, cotton batting, coffee filters, vermiculite, loam soil
- ruler
- thumb tacks
- tack board or table

### Materials & Equipment

#### Idea 3

- 30 corn seeds (about 10 seeds for each treatment and 10 untreated for comparison)
- small plastic storage bags
- absorbent material such as paper towel, cotton batting, coffee filters, filter paper
- vinegar
- baking soda solution
- thumbtacks
- tack board





**Figure 1.21** These plants can use stems to reproduce.

### Reproduction without Seeds

Seed plants don't always reproduce from seeds. Reproduction of plants that doesn't involve seeds is called **vegetative reproduction**. Plants produced by vegetative reproduction are genetically identical.

Some plants reproduce from stems. Some produce **runners**, which are long stems that grow along the surface of the soil. Other plants produce new stems that run underground called **rhizomes**. Other underground stems are produced close to the plant to make the structures we call bulbs, tubers, and corms.

Some seed plants reproduce from their roots. New plants that form on roots are called **suckers**.

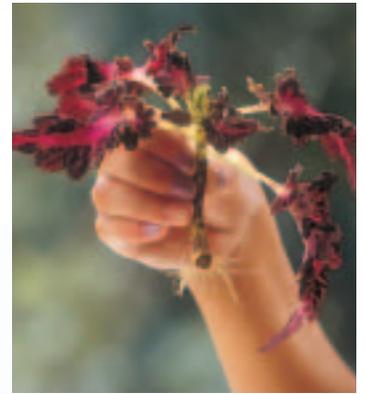
Growers often use these other ways of reproduction to produce plants. The horticultural industry produces many of the plants you see in nurseries using vegetative reproduction. For example, the millions of spring bulbs sold each year are produced this way. Suckers are used to produce new plants of fruit trees and berry plants.



**Figure 1.22** These plants can use roots to reproduce.

## Technology to Reproduce Plants

Growers also produce plants from **cuttings** and by **grafting**. Cuttings are small pieces of a plant that usually have a part of the stem and a few leaves. Almost all plants can produce new roots from a cut stem under the right conditions. Grafting is attaching a part of one plant onto another plant. Usually, a small branch of one plant is grafted. The two sections eventually grow together.



**Figure 1.23** New roots come from the stem, making a whole new plant.



**Figure 1.24** The cut pieces from another tree will eventually become a part of this one.

## CHECK AND REFLECT

1. Draw a diagram of the life cycle of seed plants. Label each stage.
2. What is a pollinator? What attracts pollinators to flowers?
3. Describe two ways that a seed plant can reproduce without seeds.
4. Describe how a nursery might produce petunias to sell as bedding plants.
5. What did you learn about conifer trees in this section that you didn't know before?

## RESEARCH

### A Plant Puzzle

Many of the plants that humans grow are seedless, such as seedless grapes and oranges. How do growers reproduce these plants?



# 1.4 Plant Structures Are Adapted To Their Environment

After a day of cross-country skiing, wouldn't it be great to come home and refresh yourself with an orange picked fresh off your own tree? Of course, this could never happen. Orange trees don't grow outdoors in Alberta because it's far too cold. But other trees, such as cottonwood and white pine, are able to grow in cold climates.

## Give it a TRY

## A C T I V I T Y

### BENEATH YOUR FEET

Seed plants come in many shapes and sizes. Even though plants may look very different, you can usually find roots, a stem, leaves, and reproductive structures.

Look at these photographs of seed plants. Identify all the plant parts you can find for each one.



Figure 1.25



Figure 1.26



Figure 1.27



Figure 1.28



Figure 1.29

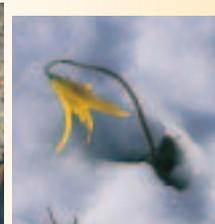


Figure 1.30

When you have identified all the plant parts you can, discuss with another student the differences in the plants in the pictures. What is different about the leaves? How about the stems?

Can you think of a reason why these structures are so different?

### infoBIT

#### Needles and Leaves

Pine and fir trees have leaves shaped like needles. The leaves of raffia palm can grow up to 20 m long and 2.4 m wide!



### CREATING A LESSON ABOUT FLOWERS

#### Recognize a Need

You're a teacher for a class of grade 1 students. Your students are learning the names for the parts of plants. Some of them are having a really hard time. Every time you show them a plant they haven't seen before, they can't name any of the parts! You need to come up with a fun way of showing your students lots of examples of the parts of plants. You're going to work with a friend to come up with a plan for showing them variations in flowers.

#### The Problem

Create a fun and interesting way to present variations in flowers.

#### Criteria for Success

For your lesson to be considered successful, it must

- show five different kinds of flowers with their parts labelled
- be creative and fun to watch
- take no more than 10 min to present

#### Brainstorm Ideas

- 1 Discuss with your partner what kind of flower variations you will present. Decide which of your ideas is most interesting and unusual.
- 2 Write a list of things you might do to present your flowers. Be creative! Maybe you can make a video, or write a song. You might want to create a game for the children to play.

#### Prepare to Present Your Lesson

- 3 Find the examples of flowers you need and transfer them onto the media you plan to use. For example, you might need to print out pictures from the Internet, or make costumes that look like different flowers.

#### Test and Evaluate

- 4 Practise your lesson presentation. Depending on what you have decided to do, you will have to do this in different ways. You might need to rehearse a skit or test your game on other students.
- 5 Make any changes to your presentation that you want after you have finished testing. You might want to test it again if you have time.

#### Communicate

- 6 It's show time! Present your lesson to the rest of your class. How did it go? Be considerate and pay attention when other students are presenting their lesson. Take notes on what you liked most about the other presentations.
- 7 Write a paragraph on your experience creating a lesson. Compare your presentation with the other presentations. What was hardest about solving this problem?

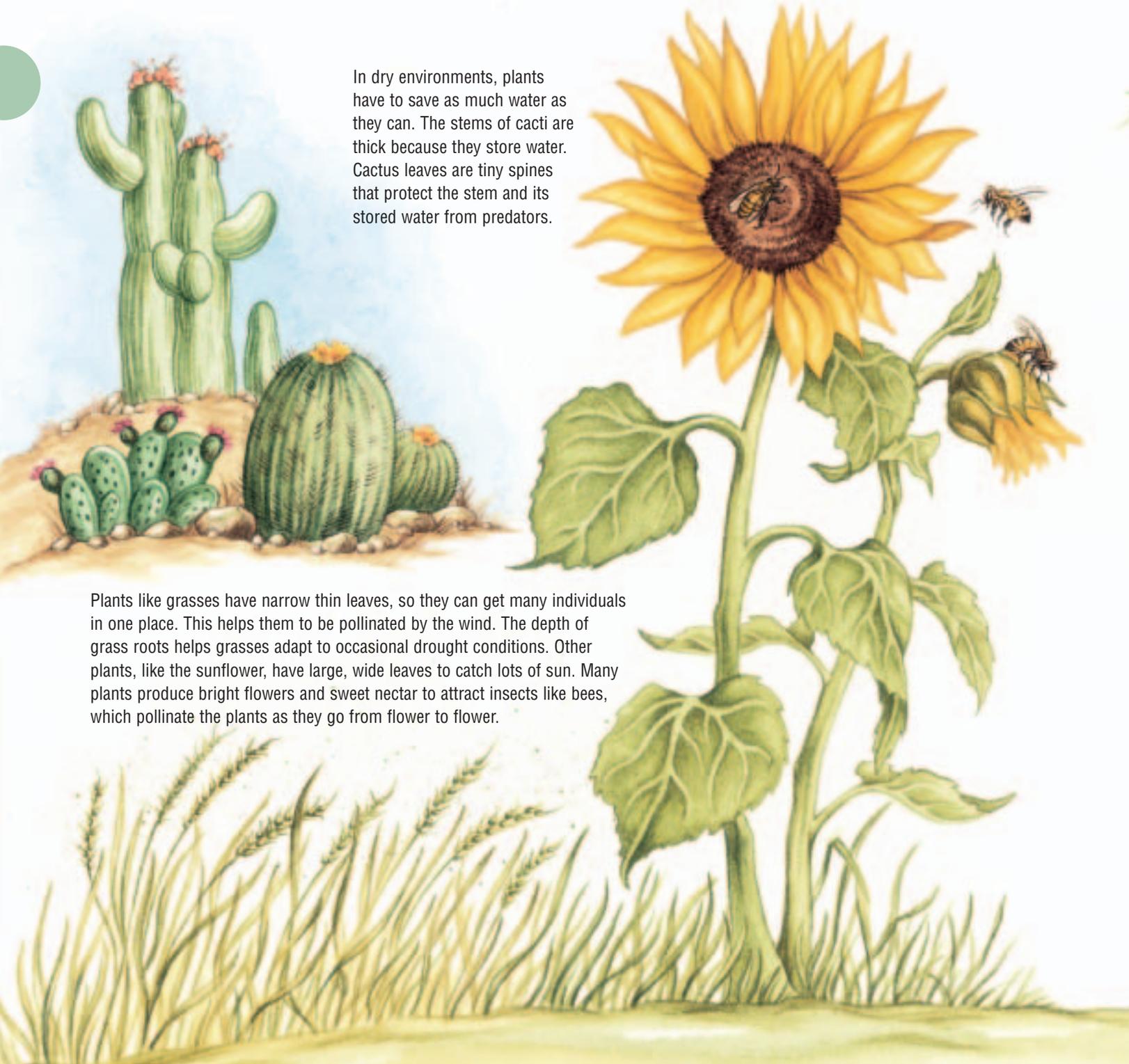


## PLANTS ARE ADAPTED TO THEIR ENVIRONMENTS

**Figure 1.31** How are these plants adapted to their environment?

When you walk into a plant nursery or go for a nature walk, you see all different sizes and shapes of plants. One of the reasons that plants are different is that they grow in different environments. To survive in a specific environment, plants must be adapted to that environment. That means that they have structures that help them survive in that environment. Figure 1.31 describes some of the many ways that plants are adapted to different environments.

In dry environments, plants have to save as much water as they can. The stems of cacti are thick because they store water. Cactus leaves are tiny spines that protect the stem and its stored water from predators.



Plants like grasses have narrow thin leaves, so they can get many individuals in one place. This helps them to be pollinated by the wind. The depth of grass roots helps grasses adapt to occasional drought conditions. Other plants, like the sunflower, have large, wide leaves to catch lots of sun. Many plants produce bright flowers and sweet nectar to attract insects like bees, which pollinate the plants as they go from flower to flower.



Plants such as white spruce trees have thin needle-like leaves with a thick resin coating. This protects the plant from drying out.

Some plants have fibrous roots, which form a thick mat that gathers water at the upper layers of the soil. Others have long taproots. These plants can get water deep down that others can't reach.



Adapted to short growing seasons, some native plants such as wild mustard produce seeds in less than two months.

## RESEARCH

### Plants in Extreme Environments

Even from a distance, the slopes of the Rocky Mountains above the treeline look barren and cold. Find out what types of plants live on or near the tops of the Rockies, and how they are adapted to this harsh environment.



**Figure 1.32** The bird of paradise flower has a unique structure.

### Plant Structures and Environments

In this subsection, you have looked at examples of variations in plant structures, such as leaves, stems, and roots. The wide range of differences in plant structures shows how plants are successfully adapted to different environments.

### CHECK AND REFLECT

1. Sketch a plant with fibrous roots and a plant with a taproot.
2. Describe two examples of variations in leaves that make a plant better suited to a specific environment.
3. Why do cacti have thick stems?
4. What kind of environments do you think these plants are adapted to?



A

B

C

D