

Three-Dimensional Geometry and Measurement

People often need to figure out how many items will fit in a given space. For example:

- When people move house, they need to pack their belongings carefully to avoid breakage and to reduce shipping costs.
- Store managers must determine how large a truck they need to deliver large items.
- You make choices about how to store your possessions. You may have collections of items that you arrange and store in special boxes.

Whether you are mailing presents to a friend or packing clothes to send to an earthquake region, an understanding of three-dimensional geometry will help you plan and use space well.

Chapter Problem

The packaging and transportation of consumer goods is a complex industry. It starts with the design of individual packages and ends with huge container loads of the product.

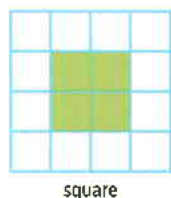
In this chapter you will consider some aspects of packaging and shipping orange juice.



Classify and Draw Polygons

A **polygon** is a closed shape whose sides are line segments. Polygons are classified by the number of sides they have.

In a **regular polygon**, the sides are all equal. Grid paper or triangle dot paper is helpful in drawing some regular polygons.



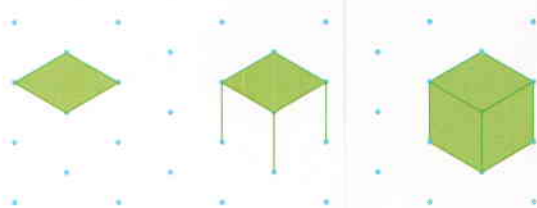
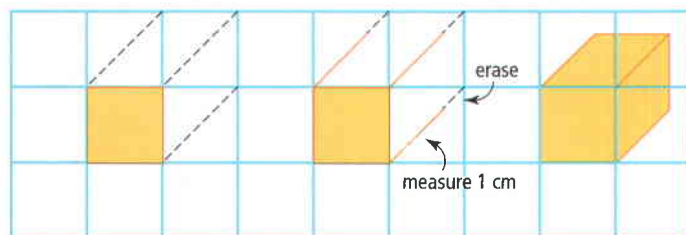
Name of Polygon	Number of Sides
Triangle	3
Quadrilateral	4
Pentagon	5
Hexagon	6
Heptagon	7
Octagon	8

1. Draw each polygon on triangle dot paper.
 - a) an equilateral triangle with side length 3 units
 - b) a regular hexagon with side length 2 units

2. Draw each polygon on grid paper.
 - a) a square with side length 3 units
 - b) a rectangle with length 4 units and width 3 units

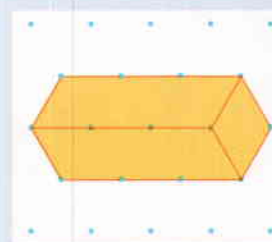
Draw Three-Dimensional Objects

Artists use a variety of techniques to show three-dimensional objects on two-dimensional paper. The diagrams show how to draw a cube, with sides measuring 1 unit, on centimetre grid paper and on triangle dot paper.



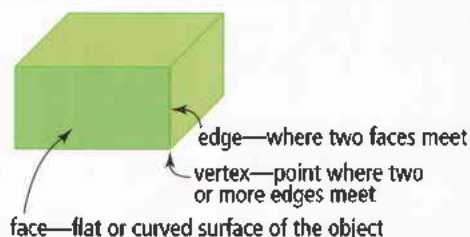
3. Draw a cube, with each side measuring 2 units,
 - a) on centimetre grid paper
 - b) on triangle dot paper

4. A box is drawn on triangle dot paper. Draw the box on centimetre grid paper.



Vocabulary of Three-Dimensional Objects

Mathematicians describe three-dimensional objects in terms of their **faces**, **edges**, and **vertices**.

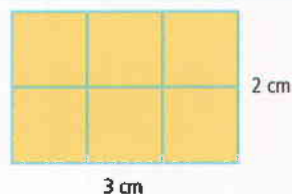


5. Use your diagram from question 4. Label each part.
- Shade in one face.
 - Outline one edge.
 - Put a coloured mark on one vertex.
6. Use a real box or visualize the box that you drew in question 4. How many of each does a box have?
- faces
 - edges
 - vertices

Area of a Rectangle

Area is the number of square units needed to cover a surface.

The area of the rectangle shown is 6 cm^2 .



7. What is the formula for calculating the area of a rectangle? Find the area of each rectangle.
- 3 m
 - 8 cm

4 cm
8. Which has the greater area? Show your calculations.
- a square with dimensions 13 m by 13 m
 - a rectangle with dimensions 14 m by 12 m
9. The area of a rectangle is 64 cm^2 . The length and width are both whole numbers of centimetres. What are the possible dimensions of the rectangle?

8.1

Explore Three-Dimensional Figures

Focus on...

- identifying and classifying geometric figures
- sketching three-dimensional figures



Some three-dimensional objects are made by combining simple shapes. Many three-dimensional objects have faces that are two-dimensional shapes. Look at the photograph. What three-dimensional shapes can you see? What two-dimensional shapes can you identify in each instrument?

Materials

- straws or stir sticks
- modelling clay

Optional

- BLM 8.1A Classifying Three-Dimensional Figures

Discover the Math

How do you classify three-dimensional figures?

1. Here are the names of some three-dimensional figures. Look around your classroom. List examples for each type of three-dimensional figure. Check and combine your list with that of a partner.



cube



rectangular prism



triangular prism



square-based pyramid



sphere



cylinder



cone

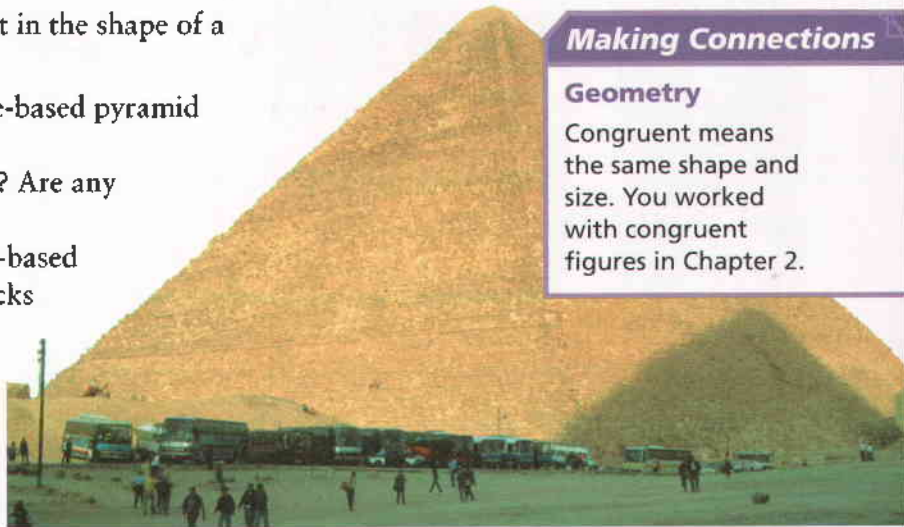
Literacy Connections

Rectangular Prism

The everyday name for a rectangular prism is a box.

2. The Egyptian pyramids were built in the shape of a square-based pyramid.

- How many faces does a square-based pyramid have, including its base?
- What is the shape of each face? Are any of them congruent?
- Construct a model of a square-based pyramid. Use straws or stir sticks for the edges and modelling clay to join them together.
- How many edges are there in the square-based pyramid? How many vertices?



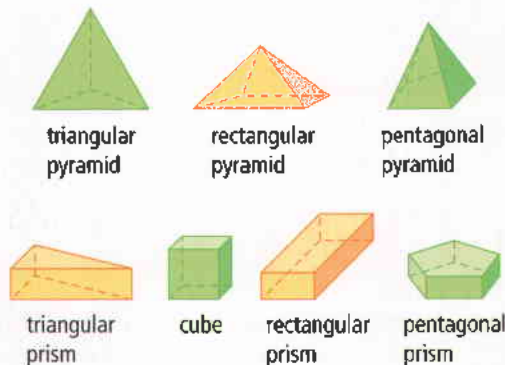
Making Connections

Geometry

Congruent means the same shape and size. You worked with congruent figures in Chapter 2.

3. a) Work in a group. Use the same materials as in step 2 to build a model of each **polyhedron** shown.

b) List the shape and the number of each type of face for each polyhedron.



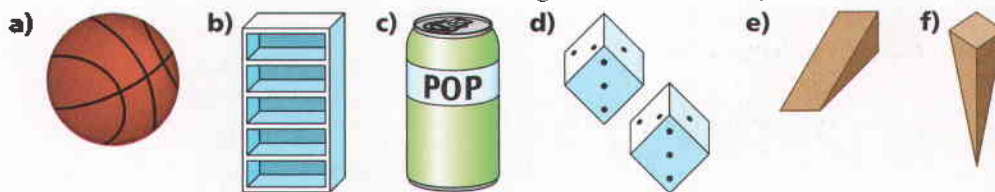
polyhedron

- a three-dimensional figure with faces that are polygons
- plural is polyhedra
- poly* means many, *hedra* means faces

4. **Reflect** Describe how pyramids and prisms are alike. Describe how they are different. What method might be used to name different types of pyramids and prisms?

Example 1: Classify Three-Dimensional Objects

Give the name of the three-dimensional figure that each object most resembles.

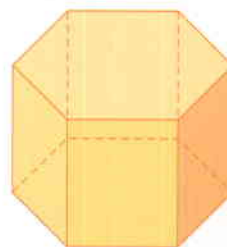


Solution

- The basketball is a sphere.
- The bookcase is a rectangular prism.
- The can of pop is a cylinder.
- The dice are cubes.
- The doorstop is a triangular prism.
- The garden stake is a square-based pyramid.

Example 2: Classify Polyhedra

Examine the figure shown. What type(s) of polygons are its faces? State the number of each type. Name the type of polyhedron.



Solution

There are two faces like this.
This is a hexagon.



There are six faces like this.
This is a rectangle.

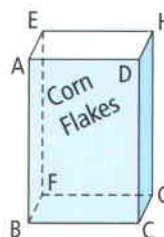


The figure is a hexagonal prism.

Example 3: Properties of Polyhedra

A cereal box is a rectangular prism.

- Name four edges of equal length.
- Name three pairs of congruent faces.



Solution

- edges: $AB = DC = HG = EF$

There are two other ways to answer this question.
 $AD = BC = FG = EH$
 $AE = DH = CG = BF$

- Faces $ABCD$ and $EFGH$ are congruent.
 Faces $ADHE$ and $BCGF$ are congruent.
 Faces $ABFE$ and $DCGH$ are congruent.

Key Ideas

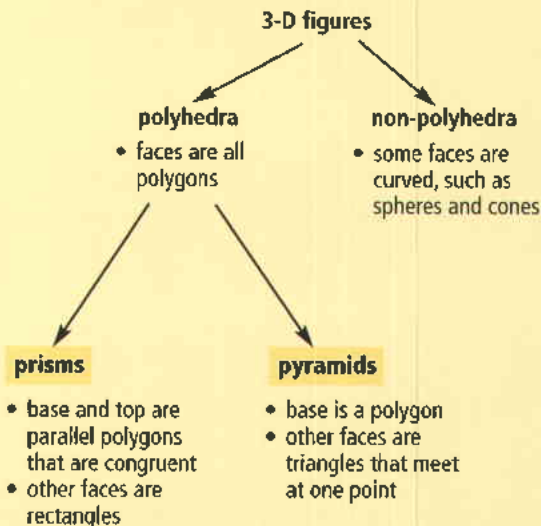
- Three-dimensional figures can be classified according to their properties.
- A polyhedron is a three-dimensional figure. All faces of a polyhedron are polygons.
- Prisms and pyramids are named according to the shape of their bases. For example,



square-based prism

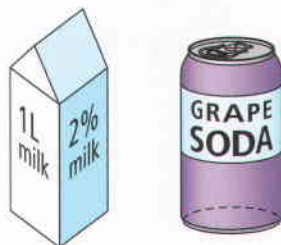


triangular pyramid

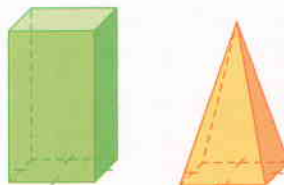


Communicate the Ideas

1. Which container is a polyhedron? Explain.



2. Compare the two figures shown. How are they alike? How do they differ? Classify each figure.

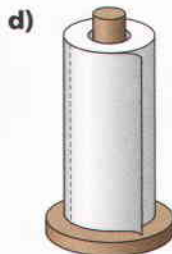
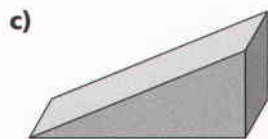
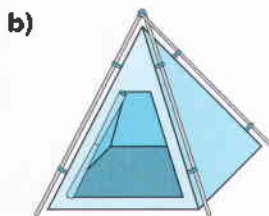


Check Your Understanding

Practise

For help with questions 3 to 5, refer to Example 1.

3. Give the name of the three-dimensional figure that each object most resembles.



4. Give the name of the three-dimensional figure that each object most resembles.

- a) a paperback book
- b) a baseball
- c) a new, unsharpened, six-sided pencil
- d) a nickel coin

5. Find and describe, or sketch, your own example of an object that has each shape.

- a) a cube
- b) a cylinder
- c) a rectangular prism
- d) a triangular prism
- e) a square-based pyramid
- f) a sphere
- g) a square-based prism

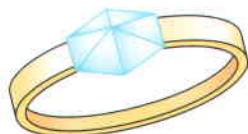
For help with questions 6 and 7, refer to Example 2.

6. Chocolates are packaged in the box shown.



- a) What type(s) of polygons are its faces? Give the number of each type.
- b) Name the type of polyhedron.

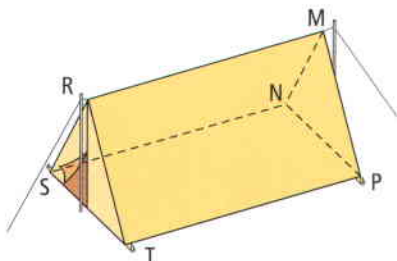
7. The jewel in a ring is shaped as shown.



- Describe the polygon shapes that form its faces. Give the number of each type.
- Name the polyhedron.

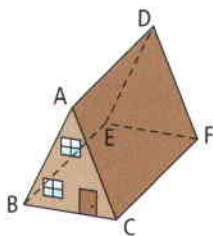
For help with questions 8 and 9, refer to Example 3.

8. A small tent has the shape shown.



- Name three edges of equal length.
- Name one pair of congruent faces.
- What type of polyhedron is this?

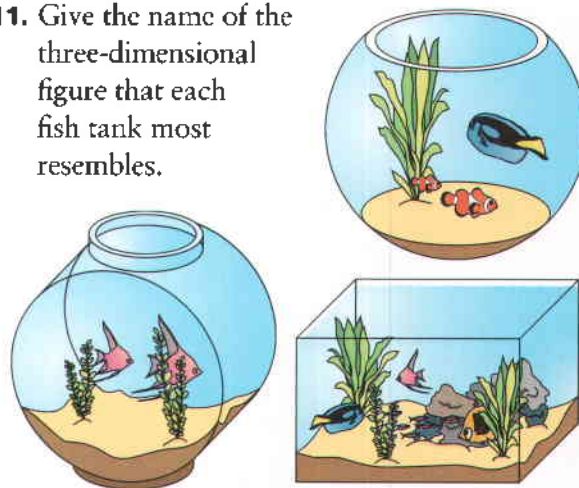
9. An A-frame cottage has the shape shown.



- Name four edges of equal length.
 - Name two different pairs of congruent faces.
 - What type of polyhedron is this?
10. Use diagrams and words to show how a pyramid and a cone are alike and how they are different.

Apply

11. Give the name of the three-dimensional figure that each fish tank most resembles.



Describe two other objects that are made in the form of different figures.

12. The shape of this house is a pentagonal prism. Look closely and you will see that it can also be divided into two different figures. The attic and roof form a triangular prism. The rooms of the house form a rectangular prism.



Draw two other objects by combining two or more three-dimensional figures. Identify the parts.

13. What three-dimensional figure am I? Sketch and name one object that fits each description.
- I have more than four faces.
 - I have only two flat faces.
 - I have two triangular faces.
 - All my faces are congruent.
 - I have one continuous surface, with no flat faces.

14. Make up some puzzles like the ones in question 13. Exchange them with another person to solve.

15.

A cube can be called a rectangular prism.



No, it is a square-based prism.



Explain why both students are correct.



16. Many office towers are rectangular prisms. Some are not.

The photo shows the building at the corner of Front and Wellington Streets in Toronto. Sketch and identify the shape.



Extend

17. Use the Internet to search for famous buildings. Describe the polyhedra used in their design. Go to

www.mcgrawhill.ca/links/math7

and follow the links to some useful Web sites.



18. a) How many identical square faces are needed to form a regular polyhedron?
b) Can any other regular polyhedron be formed with fewer faces using a different two-dimensional figure? Justify your thinking.

Did You Know?

The structure in question 16 is known as a “flatiron” building because the shape resembles an old-fashioned iron. There is a similar flatiron building in New York at Broadway and Fifth Avenue.

Making Connections

Regular Polyhedra

There are only five regular polyhedra. They are sometimes called the Platonic solids after the ancient Greek philosopher Plato. Plato, who lived in the fourth century, linked the shapes to basic elements in science. The motto inscribed over the door of Plato’s school in Athens read “Let no one ignorant of geometry enter here.”

Name of Regular Polyhedron	Shape of Each Face	Number of Faces	Science Connection
tetrahedron	equilateral triangle	4	fire
cube	square	6	earth
octahedron	equilateral triangle	8	air
icosahedron	equilateral triangle	20	water
dodecahedron	regular pentagon	12	universe



8.2

Sketch Front, Top, and Side Views

Focus on...

- sketching views of three-dimensional figures
- sketching three-dimensional objects from models and drawings



A bird's-eye view usually refers to what a bird sees as it flies overhead. Every object has a front view, a top view, and a side view.

Discover the Math

Materials

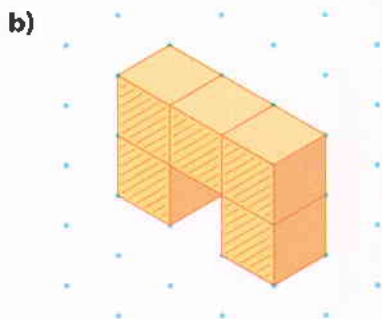
- various shaped objects
- centimetre grid paper

How do you draw views of objects?

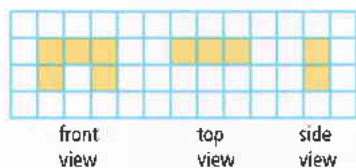
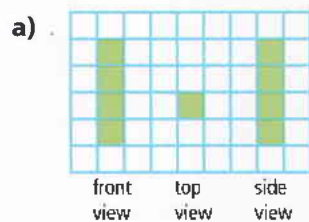
1. Look around you. Make a list of five small objects. Include a variety of shapes, such as rectangular prisms, cones, and cylinders.
2. Choose one of the objects to examine. Draw the front view of the object as a two-dimensional drawing on grid paper.
3. Draw the top view of the object. What are you doing differently here than in step 1?
4. Draw the side view of the object. Is there more than one way to do this?
5. Repeat steps 2 to 4 for the other four objects on your list.
6. **Reflect** Compare your drawings with those of other students. How many views do you need to be able to identify the object? Explain.

Example 1: Draw Front, Top, and Side Views

Models of two houses are built using linking cubes. Draw the front view, top view, and side view of each house.



Solution

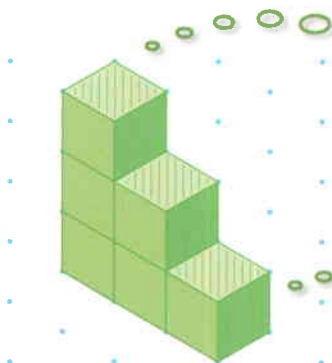
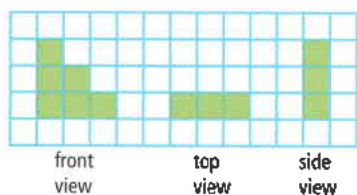


Example 2: Draw Views of a More Complex Shape

Here is a third house built with linking cubes. Draw its front view, top view, and side view.



Solution

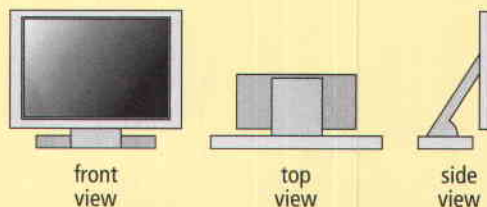


In the top view, only the faces that are facing upward are considered.

To draw the side view, only those faces that face that side are considered.

Key Ideas

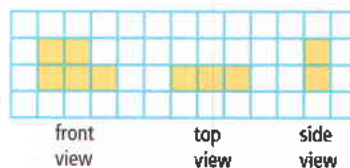
- Drawings of the front view, top view, and side view of a three-dimensional figure show how the figure appears from each of these viewpoints.



- Front views, top views, and side views are two-dimensional drawings.

Communicate the Ideas

- A building is made of five cubes. Its front, top, and side views are shown. Describe what the actual building looks like.



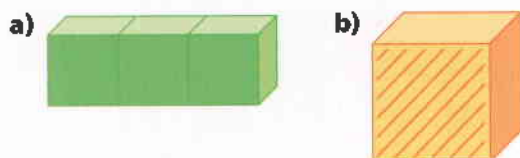
- The front view, top view, and side view of an object are all identical circles. What is the object?

Check Your Understanding

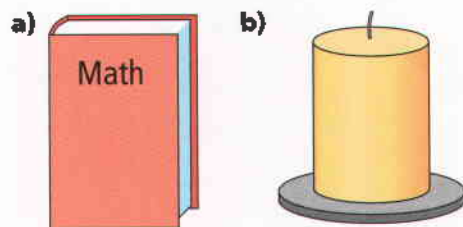
Practise

For help with questions 3 and 4, refer to Example 1.

3. Draw the front view, top view, and side view for each object. Consider the shaded face as the front.

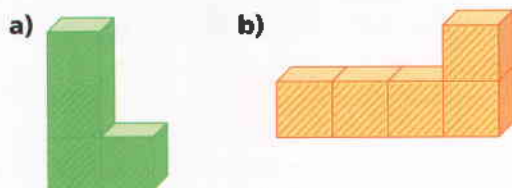


4. Draw the front view, top view, and side view for each object.

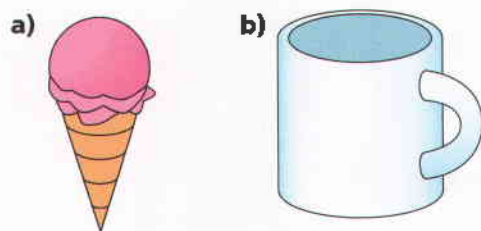


For help with questions 5 to 7, refer to Example 2.

5. Draw the front view, top view, and side view for each object. Consider the shaded face as the front.



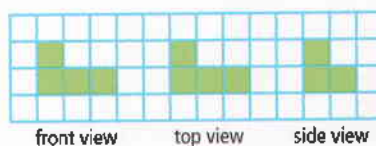
6. Draw the front view, top view, and side view for each object.



7. a) Draw the front view, top view, and side view of your eraser.
b) Exchange drawings with a partner. Draw or describe the shape of your partner's eraser.

Apply

8. The diagrams show the front view, top view, and side view of an object. Sketch the three-dimensional object.



9. The diagrams show the front view, top view, and side view of an object. Sketch the three-dimensional object.



10. What kind of figure am I?
- My top view is a circle. My front view and my side view are congruent rectangles.
 - All three views of me are circles.
 - My front view is a rectangle. My side view is a thinner rectangle. My top view is an equilateral triangle.

Did You Know?

3-D Movies and Computer Games

The first 3-D film was shown in New York on June 10, 1915. To see the three-dimensional effects, the audience wore red and green glasses. Since the 1980s, new technology has allowed much more realistic 3-D effects to be seen using special polarized lenses.

Video games use a technique called adaptive 3-D geometry. Shapes are represented by millions of tiny polygons, giving very realistic illustrations.

11. Work with a partner.

- Use six identical cubes to build a three-dimensional figure. Do not let your partner see the model.
- Draw the front, top, and side views.
- Show your partner only two of the three views. Your partner is to build the figure with another set of six cubes. Does the model match yours?
- Give your partner all three views of the model. Does this let your partner duplicate your model? Try it and see.
- Is it possible to have a hidden block or empty space not obvious in the drawings? Explain.

12. The side views drawn so far in this section have always been right-side views. Are left-side views the same as right-side views? Give examples to support your answer.



13. Imagine you are a fly on the ceiling of a room at home. Draw a top view of the room, including the top view of the furniture. Label the objects.

Literacy Connections

Floor Plans

A top view of a room is called a floor plan. Designers use floor plans to help decide where the furniture should go in a room.

To try this, draw the top view of all pieces of furniture in your room. Label each and cut it out.

Draw an outline of the room on grid paper. Include the location of doors and windows. Place the top views of the furniture on your floor plan. Move the top views around until you like the way the furniture is arranged.

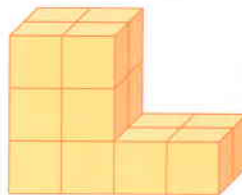
Extend

14. A mat plan is another way of representing a three-dimensional building made of cubes. On a mat plan, the top view is shown with a number telling how many cubes are in each position.

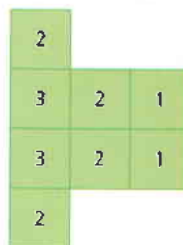
- This is the mat plan for one of the houses in the Examples at the beginning of this section. Which one is it?



- Make a mat plan for this building.



- Interpret this mat plan. Draw the front, top, and right-side views of the object.



Did You Know?

Other Dimensions

Scientists think there may be more than three dimensions. Some consider time to be the fourth dimension. Others have suggested that Earth might be a sort of shadow of a four-dimensional entity, just as your shadow is a 2-D version of your 3-D self.

8.3

Draw and Construct Three-Dimensional Figures Using Nets

Focus on...

- building three-dimensional figures from nets
- sketching three-dimensional figures from nets



Sweat shirts can be made from a single pattern piece with a hole cut out. Only two seams are needed. Each seam closes up one side and sleeve. Why might manufacturers use this method?

Discover the Math

Materials

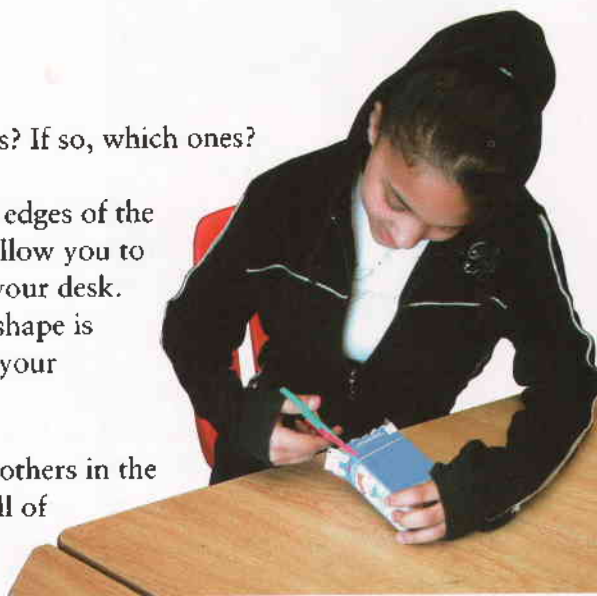
- small rectangular cardboard boxes

net

- a single flat pattern piece
- can be folded to form a three-dimensional object

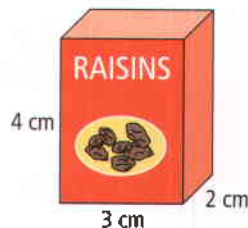
What is a net?

1. Look at a cardboard box.
 - a) How many faces are there?
 - b) What shapes are the faces?
 - c) Are there any congruent faces? If so, which ones?
2. Carefully cut along some of the edges of the box. Cut just enough edges to allow you to open the box and lay it flat on your desk. The resulting two-dimensional shape is called a **net**. Draw your net in your notebook.
3. **Reflect** Compare your net with others in the class. What is the same about all of the nets? How do they differ?

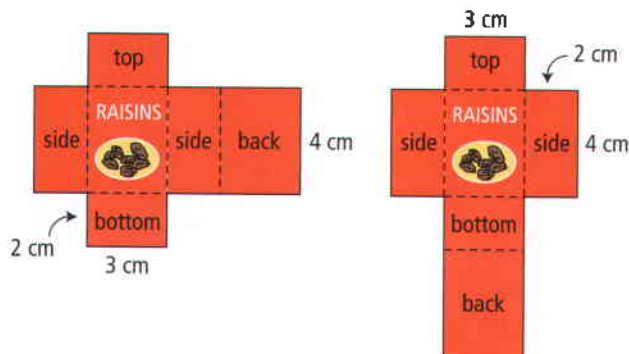


Example 1: Draw Nets

A small box of raisins measures 4 cm by 3 cm by 2 cm. Draw two possible nets for the box. Label the faces and measurements on your net.



Solution



Strategies

What other nets can be used for this box?

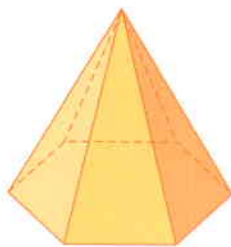
Example 2: Sketch Three-Dimensional Objects From Nets

Examine the net. Sketch the three-dimensional object that can be made from it. What type of figure is formed?



Solution

Method 1: Trace and Build the Object



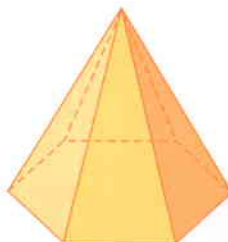
Strategies

Make a model

The three-dimensional figure formed is a hexagonal pyramid.

Method 2: Visualize the Object

The net has one regular hexagon and six congruent triangles. When the triangles are folded up, the three-dimensional figure formed is a hexagonal pyramid.



Literacy Connections

Prisms and pyramids are two classes of three-dimensional figures. A particular prism or pyramid is named according to the shape of its base.

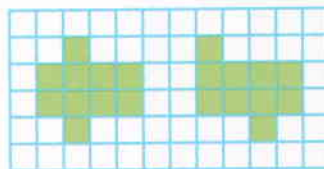
Key Ideas

- A net is a two-dimensional drawing that can be folded up to form a three-dimensional figure. It is a single pattern piece that shows all the faces of the figure.



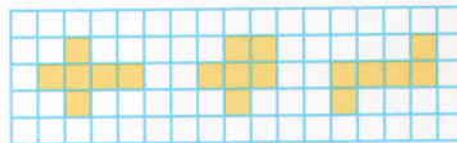
Communicate the Ideas

1. Will the nets shown make two identical three-dimensional figures? Explain.



2. Here are three possible nets.

Which net will not form a cube?
Justify your choice.

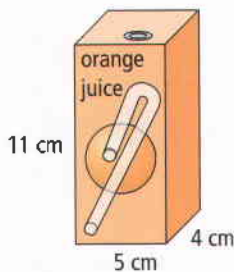


Check Your Understanding

Practise

For help with questions 3 and 4, refer to Example 1.

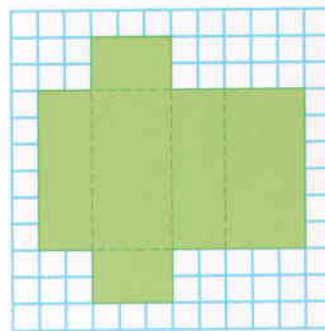
3. A small juice box measures 11 cm by 5 cm by 4 cm. Draw a net for the box. Show the measurements of each face.



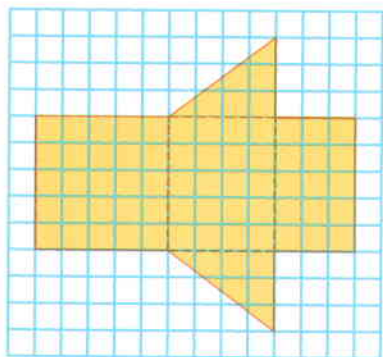
4. Playing cards are sold in a box measuring 6 cm by 9 cm by 2 cm. Draw a net for the box. Show the measurements of each face.

For help with questions 5 to 9, refer to Example 2.

5. Make a larger copy of the net on centimetre grid paper. Cut out the net and fold along the dotted lines. Tape the edges to form a three-dimensional figure. What type of figure is it?



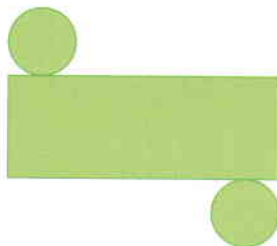
6. Make a larger copy of the net on centimetre grid paper. Cut out the net and fold along the dotted lines. Tape the edges to form a three-dimensional figure. What type of figure is it?



7. a) Sketch the three-dimensional figure that can be made from this net.



- b) Name the type of polyhedron.
c) Describe an item at the store that is packaged in this way.
8. a) Sketch the three-dimensional figure that can be made from this net.

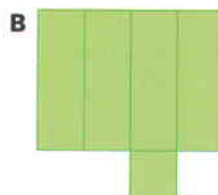
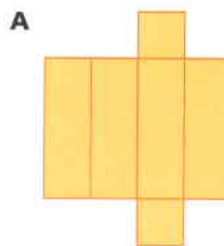


- b) What can be packaged using this type of net?
9. Sketch the three-dimensional figure that can be made from this net. What type of figure is formed?

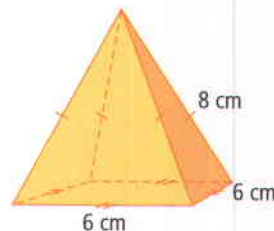


Apply

10. Two nets are shown. What three-dimensional figure will each net form? How are the two figures alike? How are they different?



11. Decide which edges of a square-based pyramid you would need to cut to form its net.



- a) Draw a net for the square-based pyramid on centimetre grid paper.
b) Construct a three-dimensional model of the square-based pyramid using your net.

Did You Know?

Most people are familiar with the ancient pyramids in Egypt. Many other cultures built in this shape too. Pyramid structures, or partial remains of them, are found in India, Peru, Mexico, Greece, China, Japan, Tibet, Cambodia, Brazil, Bolivia, and Spain. Perhaps you know of other locations too.

Chapter Problem

12. A single-serving orange juice box measures 10 cm by 7 cm by 5 cm. Draw a net for the box. Print the words ORANGE JUICE on each face except the bottom, so the words will read the correct way when the box is assembled. Add artwork if you like. Mark the position of the hole for the straw.

13. Design a small paper-recycling bin. It is to have a square base and is open at the top. The square top is larger than the base.



- What shape is each of the side faces?
- Draw a net for the bin.
- Cut out the net and tape it together to form the bin.

- 14.** Use a net to construct a model of each pyramid. Sketch three-dimensional drawings of them in your notebook.
- a triangular pyramid that is made up of four equilateral triangles
 - a triangular pyramid where only the base is an equilateral triangle and the other three faces are congruent isosceles triangles



15. Design a net for a new rectangular package for crackers. Which net will you use? Sketch it. Explain why you chose this design.

Extend

- 16.** There are 11 different nets for a cube. Try to draw them all. Make sure they are actually different. Some may be the same when you turn or flip them over. How can you check that they are all different?

Making Connections

Gift Box Set

The nets used to form the packaging of some items, such as toys and dishes, are quite complex and may include cut-out holes to hold breakable parts. Most gift boxes are designed to have a top lid that fits over the bottom container. Sometimes the lid is separate, sometimes not.

- Design a special gift box. Think of an item you want to package. Then, decide on the shape of box you will use.
- Draw the net(s) for your gift box. Cut out the net(s) and make the gift box. Test and modify your design until you are pleased with it.

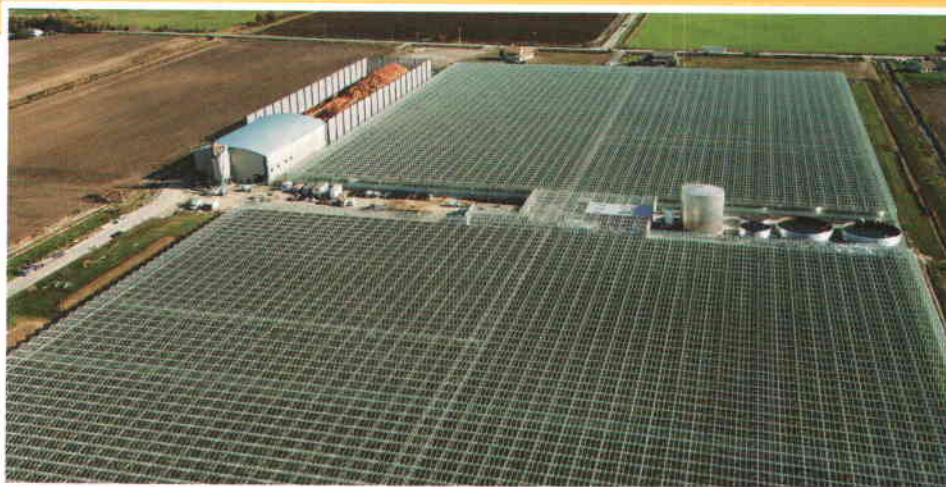


8.4

Surface Area of a Rectangular Prism

Focus on...

- developing the formula for the surface area of a rectangular prism



Essex County, in southwestern Ontario, has the greatest concentration of greenhouse agriculture in all of North America. In the Leamington area, some greenhouses are as large as 400 m by 200 m. A greenhouse allows solar energy to pass through its glass and become heat energy.

Discover the Math

Materials

- centimetre cubes or other identical cubes
- centimetre grid paper

Optional

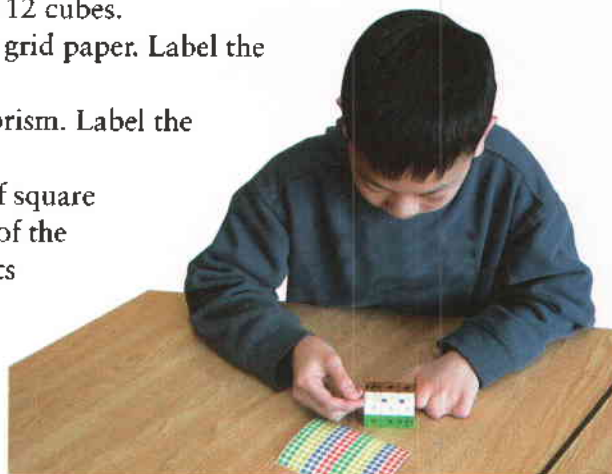
- BLM 8.4A Surface Area

surface area

- the number of square units needed to cover an object

How can you find the surface area of a rectangular prism?

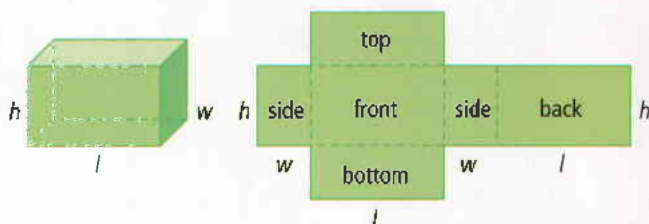
1. a) Make a prism using 12 cubes.
 - b) Sketch the prism on grid paper. Label the dimensions.
 - c) Draw a net for the prism. Label the dimensions.
 - d) Count the number of square faces on the outside of the prism. This represents the **surface area** of the prism. Check the count using the net.



2. Repeat question 1 to obtain data for as many different prisms as you can make using 12 cubes.

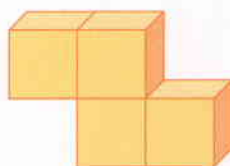
3. How many faces are there in a net of any rectangular prism?
Which pairs of faces are congruent? How many pairs are there?

4. **Reflect** The surface area of an object is the sum of the areas of its faces. Describe how to find the surface area of a rectangular prism with length l , width w , and height h .



Example 1: Find Surface Area

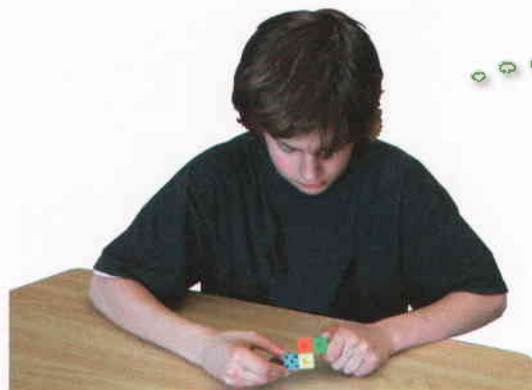
The figure is made with four centimetre cubes.
What is its surface area?



Solution

There are many ways to solve this problem. Here are two methods.

Method 1: Build the Figure



Strategies

What other method might be used?

Strategies

Make a model

There are 18 exposed cube faces. Each face has an area of 1 cm^2 .
The surface area of the figure is $18 \times 1 \text{ cm}^2$, or 18 cm^2 .

Method 2: Count the Number of Cube Faces on Each View

front view and back view: $4 + 4 = 8$

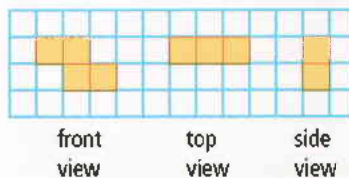
top view and bottom view: $3 + 3 = 6$

side views: $2 + 2 = 4$

Total number of cube faces: $8 + 6 + 4 = 18$

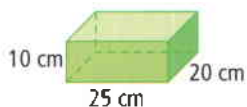
Each face has an area of 1 cm^2 .

The total surface area of the figure is 18 cm^2 .



Example 2: Calculate Surface Area

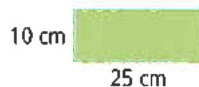
Sarah makes her own gift boxes. She glues wrapping paper onto the outside to make them look nice. One box has length 25 cm, width 20 cm, and height 10 cm. How much paper does she need to cover all six faces of the box?



Solution

Method 1: Find the Area of the Different Faces

Front face:



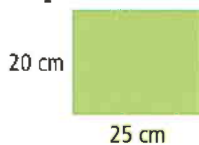
$$A = l \times w$$

$$A = 10 \times 25$$

$$A = 250$$

The back face has the same area as the front face, 250 cm².

Top face:



$$A = 20 \times 25$$

$$A = 500$$

The base has the same area as the top face, 500 cm².

Left-side face:



$$A = 10 \times 20$$

$$A = 200$$

The right-side face has the same area as the left-side face, 200 cm².

Surface area = front + back + top + base + left side + right side

$$\begin{aligned} \text{S.A.} &= 250 + 250 + 500 + 500 + 200 + 200 \\ &= 1900 \end{aligned}$$

Sarah will need at least 1900 cm² of wrapping paper to cover the box.

Method 2: Use a Formula

$$l = 25, w = 20, h = 10$$

$$\begin{aligned} \text{S.A.} &= 2(l \times w) + 2(l \times h) + 2(w \times h) \\ &= 2(25 \times 20) + 2(25 \times 10) + 2(20 \times 10) \\ &= 1000 + 500 + 400 \\ &= 1900 \end{aligned}$$

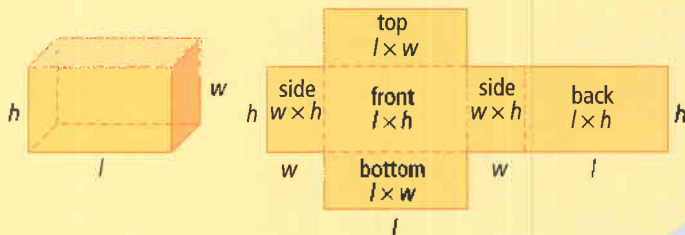
Sarah will need at least 1900 cm² of wrapping paper to cover the box.

Strategies
Choose a formula

Key Ideas

- The surface area of a prism is the sum of the areas of all of its faces.
- The formula for the surface area of a rectangular prism is

$$\text{S.A.} = 2(l \times w) + 2(l \times h) + 2(w \times h)$$
- Surface area is measured in square units.



Communicate the Ideas

1. A rectangular prism and its net are shown.

Jasmine looks at the net. She calculates the surface area of the box by finding the area of each of the six rectangles and then adding these areas.

Her work shows

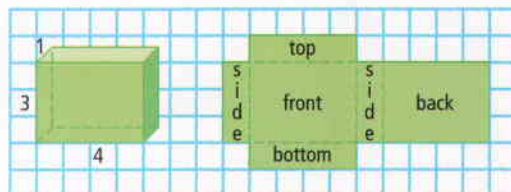
$$\begin{aligned} \text{S.A.} &= \text{left side} + \text{top} + \text{front} + \text{bottom} + \text{right side} + \text{back} \\ &= 1 \times 3 + 4 \times 1 + 4 \times 3 + 4 \times 1 + 1 \times 3 + 4 \times 3 \end{aligned}$$

How can Jasmine simplify her work? Explain.

2. Sianni says she looks at the sketch of the box and uses the formula for surface area. Her work shows

$$\text{S.A.} = 2(3 \times 4) + 2(4 \times 1) + 2(3 \times 1)$$

Is Sianni right? Explain.



Check Your Understanding

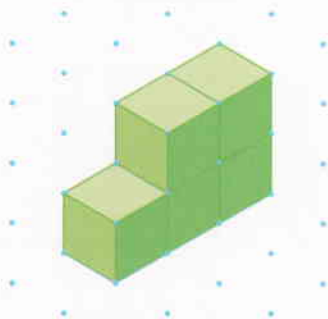
Practise

For help with questions 3 and 4, refer to Example 1.

3. The figure is made with four centimetre cubes. What is its surface area?

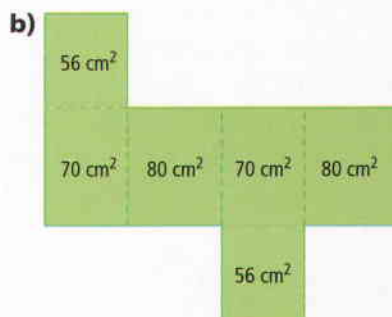
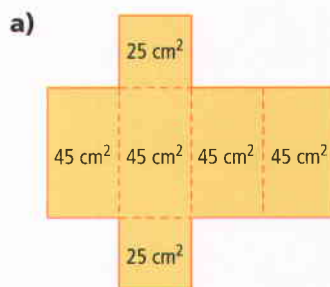


4. The figure is made with five centimetre cubes. What is its surface area?

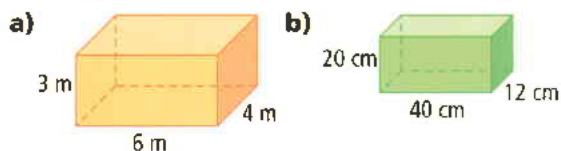


For help with question 5 to 7, refer to Example 2.

5. Find the surface area of the rectangular prism made from each net.



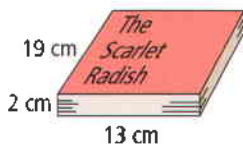
6. Calculate the surface area of each rectangular prism.



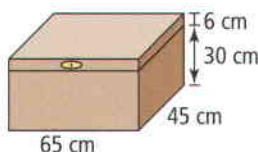
7. Measure the length and width of the front cover of this textbook, to the nearest centimetre. Find the area of cardboard needed to make the front and back covers.

Apply

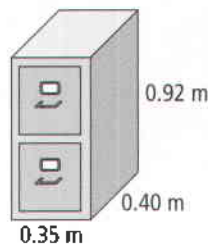
8. Match each cube-shaped object with its approximate surface area. Three possible areas are given for each. Explain how you reached your conclusions.
- a) an ice cube: 6 cm^2 , 54 cm^2 , 300 cm^2
 - b) a small room: 24 m^2 , 100 m^2 , 12 m^2
 - c) one number key on a touch-tone phone: 1 cm^2 , 6 cm^2 , 20 cm^2
9. Willem wants to protect his favourite paperback book by covering it with sticky transparent paper. He will cover the front, spine, and back of the book. What area of sticky paper will he need?



10. Jean plans to build a wooden chest. The length is 65 cm, the width is 45 cm, and the height is 30 cm. The lid has a height of 6 cm and is attached with hinges so it fits perfectly with no overlap. How much wood does Jean need to build the rectangular chest?



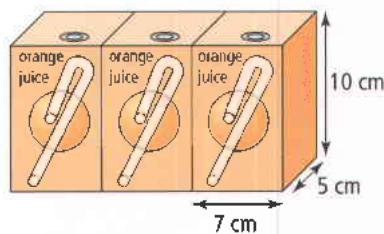
11. Kallil helps in his mother's office. He is asked to wipe away the dust from a filing cabinet. The cabinet measures 0.35 m by 0.40 m by 0.92 m. Its back is against the wall. What is the exposed surface area that Kallil has to wipe?



12. Freya wants to paint her bedroom door and the closet door, but she is not sure if she has enough paint. Both doors measure 2.0 m tall, 0.7 m wide, and 0.05 m thick. Freya has one can of paint that says it covers 3.5 m^2 . Does she have enough to paint all sides, except the bottoms, of both doors?
13. For what type of rectangular prism is the area of each face the same? Sketch the prism. Write a simplified formula for its surface area.

Chapter Problem

14. Single-serving orange juice boxes measure 10 cm by 7 cm by 5 cm.
- a) After it is filled, each box is covered with a thin coat of wax. This coating seals the box and helps to preserve the juice. Find the area of each juice box to be coated.
 - b) Packs of three boxes are shrink-wrapped for sale. Find the area of plastic needed to wrap three boxes.



15. Use eight cubes. Can you construct different rectangular prisms that have the same surface area? If so, sketch the figures and draw nets for them. If not, explain why not.

16. George has a cube-shaped box that he wants to gift-wrap. Each edge of the cube measures 30 cm. A local stationery store sells sheets of wrapping paper in three sizes.

A: 60 cm by 60 cm

B: 80 cm by 80 cm

C: 90 cm by 90 cm

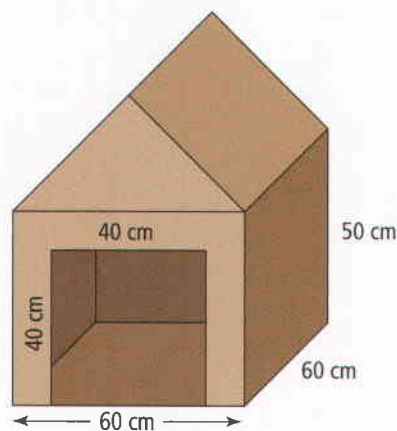
Which size should George buy?

Explain your choice.



17. Pat built a doghouse. She cut out a square hole in the front for the entrance.

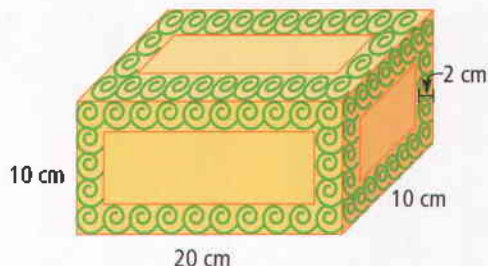
Pat wants to paint the outside walls blue. She will not paint the roof or the triangular gable ends. What surface area does she plan to paint?



Extend

18. The top and bottom of Kelly's jewellery box both measure 12 cm by 12 cm. The other four faces are congruent to each other. The surface area of the box is 768 cm^2 . What is the height of the jewellery box?

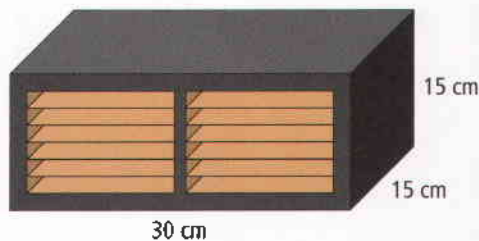
19. A box with dimensions of 20 cm by 10 cm by 10 cm has a 2-cm-wide decorative border along all its edges. What is the surface area not covered by the border?



20. Cora bought a CD player, 2 CDs, and a CD holder for her son's birthday.



12 cm



30 cm



15 cm

- a) Suggest possible sizes for each gift box, if the items are placed into
- one box
 - two boxes
 - three boxes
- b) How many boxes would you use? Explain why.

8.5

Volume of a Rectangular Prism

Focus on...

- developing a formula for the volume of a box



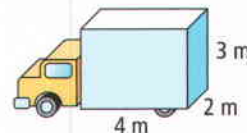
The truck is being loaded with supplies for a store. The supplies have been packaged into crates. Each crate measures 1 m by 1 m by 1 m. There are 24 crates to be shipped. The truck box has length 4 m, width 2 m, and height 3 m. How can you find out whether all of the crates will fit in one load?

Discover the Math

Materials

- centimetre cubes

How can you find volume?



1. Consider the truck box to be a rectangular prism with dimensions 4 m by 2 m by 3 m.
 - a) Build a model of the truck box using centimetre cubes. Let one centimetre represent one metre.
 - b) How many cubes did you use to form the bottom layer of the rectangular prism? What is the area of the floor of the truck box?
 - c) How many layers of cubes are there?
 - d) How many cubes did you use altogether to build the rectangular prism? This is its **volume**.
2. What if the truck box measured 5 m by 2 m by 3 m? Complete parts a) to d) of step 1 for this truck box.

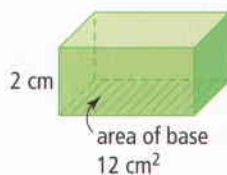
volume

- the amount of space occupied by an object
- measured in cubic units

- What if the truck box measured 6 m by 2 m by 3 m? How many cubes would you need to construct a model of this truck box?
- Compare the three truck boxes. How is the number of cubes used related to the area of the base (the floor of the truck box) and the height?
- Reflect** Describe how to find the volume of a rectangular prism in terms of the area of its base and its height.

Example 1: Calculate Volume

The area of the base of a box of toothpicks is 12 cm^2 . The height of the box is 2 cm. Find the volume of the box.



Solution

Volume = area of base \times height

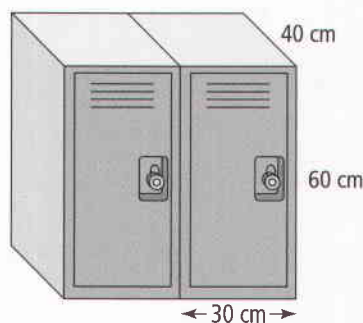
$$V = 12 \times 2$$

$$V = 24$$

The volume of the box of toothpicks is 24 cm^3 .

Example 2: Solve a Problem Involving Volume

Students in the drama club plan to store costumes in two lockers. They need to know how much space they have. What is the volume of the two lockers shown?



Solution

Find the volume of one locker.

$$l = 40, w = 30, h = 60$$

Volume = area of base \times height

$$V = 40 \times 30 \times 60$$

$$V = 72\,000$$

The volume of one locker is $72\,000 \text{ cm}^3$.

The volume of two lockers is $2 \times 72\,000 \text{ cm}^3$, or $144\,000 \text{ cm}^3$.

The base is a rectangle, 40 cm by 30 cm.

Literacy Connections

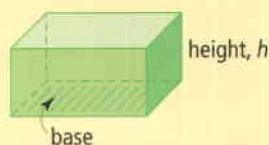
Cubic Units

The volume 24 cm^3 is read “twenty-four cubic centimetres.” The raised 3 refers to cubic units. Cubic units are used for the volume of a three-dimensional space.

Strategies
Choose a formula

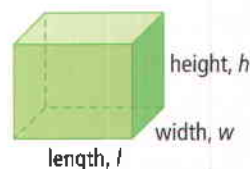
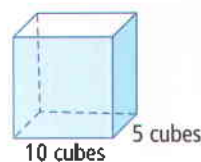
Key Ideas

- Volume is the amount of space occupied by an object.
- The formula for the volume of a rectangular prism is
 $\text{Volume} = \text{area of base} \times \text{height}$
- Volume is measured in cubic units.



Communicate the Ideas

- Sugar cubes are packaged in a box. On the bottom layer, there are 5 rows of 10 cubes. There are 500 cubes altogether in the box. How many layers are there? Explain.
- Another formula for the volume of a rectangular prism is
 $V = l \times w \times h$
Explain why this formula is equivalent to the formula
 $\text{Volume} = \text{area of base} \times \text{height}$

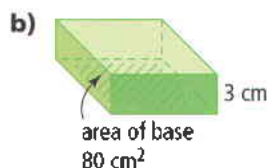
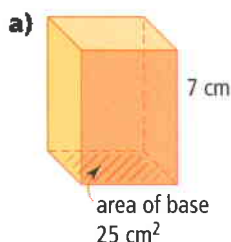


Check Your Understanding

Practise

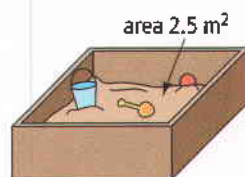
For help with questions 3 and 4, refer to Example 1.

- The area of the base and the height of each box are given. Calculate the volume of each box.



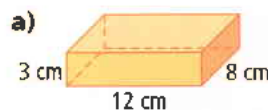
- A sandbox has a base area of 2.5 m². What volume of sand is needed to fill the sandbox to each depth?

- a) 0.4 m b) 0.5 m
c) 0.24 m



For help with questions 5 to 7, refer to Example 2.

- Calculate the volume of each rectangular prism.



6. Calculate the volume of each rectangular prism.
- a) a box for a tube of toothpaste measures 19 cm by 5 cm by 3 cm
 - b) a box of tissues measures 22 cm by 12 cm by 7 cm
 - c) a classroom measures 10 m by 8 m by 3 m

Apply

7. What does 1 m^3 look like? Choose the most likely object. Justify your choice.
- A a microwave oven
 - B a washing machine
 - C a toaster
8. What does 10 cm^3 look like? Choose the most likely object. Justify your choice.
- A a dictionary
 - B a lunch box
 - C an eraser
9. Ashley is at summer camp and is feeling homesick. She asks her mother to send her old teddy bear. The bear fits snugly into a box measuring 24 cm by 10 cm by 18 cm. What is the volume of the box?
10. Ben decides to take a cooler of drinks with him to the beach. He fills one third of the space in the cooler with ice. The cooler measures 65 cm by 30 cm by 40 cm. What volume is left for his drinks?
11. Sanjay bought a fish tank that has length 40 cm, width 25 cm, and height 30 cm.
- a) What is the volume of the tank, in cubic centimetres?
 - b) One litre of water has a volume of 1000 cm^3 . How many litres of water are needed to half fill the tank?

Chapter Problem

12. Single-serving orange juice boxes measure 10 cm by 7 cm by 5 cm. Packs of three boxes are shrink-wrapped for sale at the grocery store. Find the volume of juice in a three-pack.

13. Usaf works at a bakery. His job is to carefully pack items for shipping to stores. Five small cakes take up 600 cm^3 . How many of these cakes can be put in a crate that measures 120 cm by 80 cm by 50 cm?



14. Jenna is moving to a new apartment. She wants to have all her books shipped so she has decided to buy some storage boxes. There are three different sizes available.

A: 60 cm by 50 cm by 45 cm

B: 70 cm by 45 cm by 40 cm

C: 65 cm by 40 cm by 40 cm

- a) Draw a sketch of each box and label its dimensions.
- b) Find out as much as you can about the boxes. Consider the volume and the surface area of each size.
- c) What are the advantages and the disadvantages of each size?
- d) Which size should Jenna choose to move her books? Give reasons for your answer.

Extend

15. Vijnya bought a picnic basket that is 32 cm long and 20 cm wide. The storekeeper told her that the basket has a volume of 7360 cm^3 . Make a sketch of the basket. What is the picnic basket's depth?

16. A certain cube has the same number of cubic units for its volume as the number of square units it has for its surface area. What are the possible dimensions of this cube?

Key Words

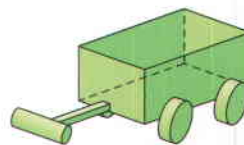
For questions 1 to 6, copy the statement and fill in the blanks. Use some of these words: *net, polygons, prism, pyramid, rectangles, space, square, surface area, two, three*

1. A polyhedron is a -dimensional figure with faces that are .
2. A is a two-dimensional pattern that can be folded up to form a three-dimensional figure.
3. A is a polyhedron that has one base and the same number of triangular faces as there are sides on the base.
4. A is a polyhedron that has two parallel and congruent polygon bases, with rectangular faces connecting them.
5. Volume is the amount of occupied by an object.
6. The of an object is the sum of the areas of its faces.

8.1 Explore Three-Dimensional Figures, pages 236–241

7. Sketch and name a polyhedron that fits each description.
 - a) one square face and four triangular faces
 - b) 12 edges of equal length
 - c) six vertices
8. Can you find more than one solution to any of the parts in question 7? Show other solutions where possible.

9. The toy wagon shown consists of different three-dimensional figures.

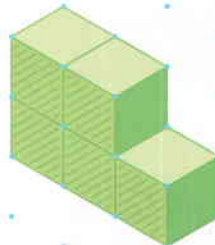


- a) Name the different parts of the wagon and the three-dimensional figure each part most resembles.
- b) Draw two other objects that are combinations of two or more three-dimensional figures.

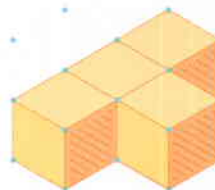
8.2 Sketch Front, Top, and Side Views, pages 242–246

10. Draw the front view, top view, and side view for each figure.

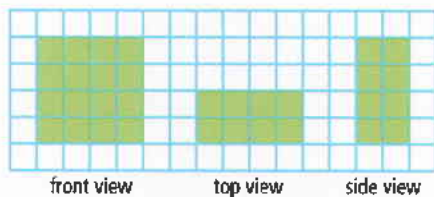
a)



b)

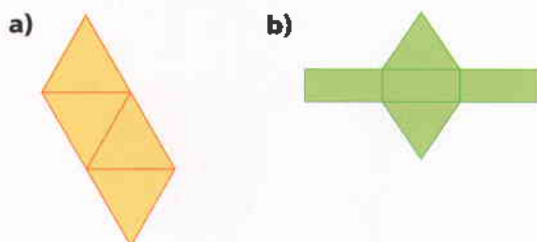


11. Sketch the three-dimensional figure that has the following front view, top view, and side view.



8.3 Draw and Construct Three-Dimensional Figures Using Nets, pages 247–251

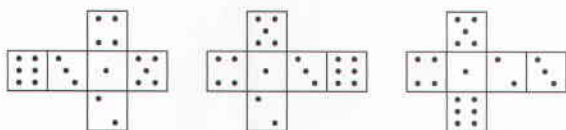
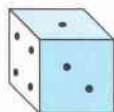
12. Name the polyhedron that can be made by folding each net.



13. Draw a possible net for each polyhedron.

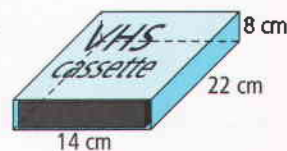
- a) a square-based pyramid
b) a square-based prism

14. Which net will fold to make the standard die shown? Explain why the other two will not.

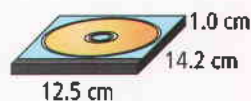


8.4 Surface Area of a Rectangular Prism, pages 252–257

15. Find the surface area of the video box shown.



16. Kristin works for a CD packaging plant. Each CD case measures 14.2 cm by 12.5 cm by 1.0 cm, and is tightly covered with plastic wrap.



- a) How much plastic wrap is needed to cover one CD case?
b) How much plastic wrap should Kristin order to wrap 2000 CD cases?

8.5 Volume of a Rectangular Prism, pages 258–261

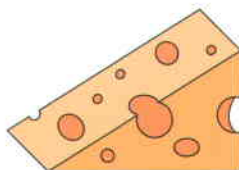
17. Danny ordered a pizza for lunch. It was delivered in a box measuring 30 cm by 30 cm by 5 cm. What is the volume of the pizza box?
18. Ken bought a vase for a wedding gift. He wants to put the vase in a box, along with some foam chips, before he has it gift-wrapped. The box measures 12 cm by 12 cm by 25 cm. If the vase takes up half of the box, what volume of foam chips are needed?
19. Maki is packing for a long trip. She wants to take all the clothes that are stuffed in her dresser drawer. The dimensions of the drawer are 65 cm by 55 cm by 30 cm. Does she have enough room for the clothes if her suitcase measures 80 cm by 45 cm by 25 cm?

Multiple Choice

For questions 1 to 4, select the correct answer.

1. A wedge of cheese most resembles a

- A square-based pyramid
B rectangular prism
C triangular prism
D cone



2. The side view of a cylinder, such as the hockey puck shown, is a

- A circle
B square
C triangle
D rectangle



3. The surface area of the rectangular prism shown is

- A 100 cm^2
B 200 cm^2
C 300 cm^2
D 400 cm^2

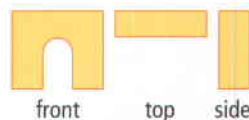


4. The volume of a classroom that measures 8 m by 10 m by 4 m is

- A 84 m^3
B 196 m^3
C 320 m^3
D 384 m^3

Short Answer

5. Draw a sketch of the three-dimensional figure that has the following front view, top view, and side view.

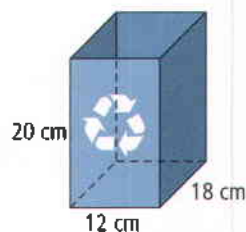


6. a) Sketch a polyhedron that has six faces. Name the polyhedron.
b) Draw a net for this polyhedron.
c) Sketch a different polyhedron that also has six faces.

7. What is the total surface area of the two fuzzy dice? They are identical in size. Each edge measures 9 cm.



8. Aaron plans to make a recycling bin out of cardboard. He wants it to have length 18 cm, width 12 cm, and height 20 cm. The bin does not need a lid.



- a) What area of cardboard does he need to make the recycling bin?
b) How much space will the bin take up?

9. a) Draw a prism with two square bases and four rectangular faces.
 b) Is it possible to have a prism that consists of two rectangular faces and four square faces? Use sketches or models to help you explain your answer.

Extended Response

10. a) Sketch two different three-dimensional figures you can build using two of these triangular prisms.

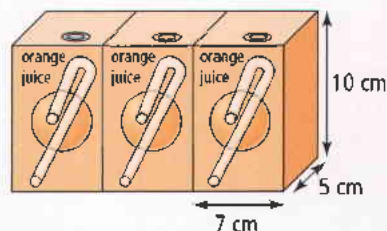


- b) Draw the front view, top view, and side view of each figure.
 c) Draw a net for each figure.

11. Rhianne plans to build a sandbox. She has 1.6 m^3 of sand. If she makes the box square, with each side 2.0 m long, how deep should she make the sandbox? Sketch a diagram of the sandbox and explain your result.
12. Suppose you want to wrap two objects, each with a volume of 12 cm^3 . One object is a key chain in a box that is almost a cube. The other is a pen in a long thin box.
- a) Which box will need more wrapping paper? Explain your reasoning.
 b) What strategy or strategies work well to help you answer this problem?

Chapter Problem Wrap-Up

Single-serving orange juice boxes measure 10 cm by 7 cm by 5 cm . Packs of three boxes are shrink-wrapped for sale at grocery stores. The packs are shipped from the wholesaler in cartons containing 48 three-packs.



- Design a carton that can be used by the wholesaler. Use pictures, words, and numbers to describe your design to a possible buyer. Include all important measurements.
- Is your design the only possible one? If others are possible, show them.
- Which carton design do you think is best for shipping the juice boxes? Why?

Making Connections

Convert Among Units

You can use the basic length conversions to find the related conversions for area and for volume.

Length: $1 \text{ m} = 100 \text{ cm}$

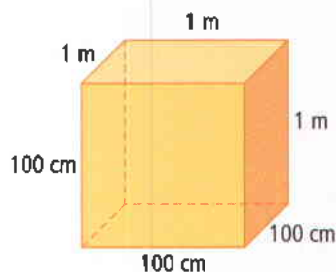
Area: A square with side length 1 m has an area of $1 \text{ m} \times 1 \text{ m}$, or 1 m^2 .

In centimetres, the area of the square is $100 \text{ cm} \times 100 \text{ cm}$, or $10\,000 \text{ cm}^2$.

So, $1 \text{ m}^2 = 10\,000 \text{ cm}^2$.

Volume: A cube with side length 1 m has volume of $1 \text{ m} \times 1 \text{ m} \times 1 \text{ m}$, or 1 m^3 .

In centimetres, the volume of the cube is $100 \text{ cm} \times 100 \text{ cm} \times 100 \text{ cm}$, or $1\,000\,000 \text{ cm}^3$.



Making Connections

What's math got to do with architecture?

Architects combine technical skills with artistic sense and creativity. They draw several plans to provide different views of a new building's design. Sometimes they build a scale model.

1. Research architects' drawings on the Internet. Go to



www.mcgrawhill.ca/links/math7 and

- follow the links to some useful Web sites. Does each architect's view show the same amount of detail?
2. Which building trades use architects' drawings? Describe how they use them.
3. What three-dimensional shapes can you identify in the design of the Northern Ontario cottage shown here?



Design a Stage

The Prisms, a four-person band from Ireland, are coming to your school. You have the job of designing the stage. The school stage is square and has an area of 36 m^2 .

The Prisms' stage manager sends the following e-mail message.

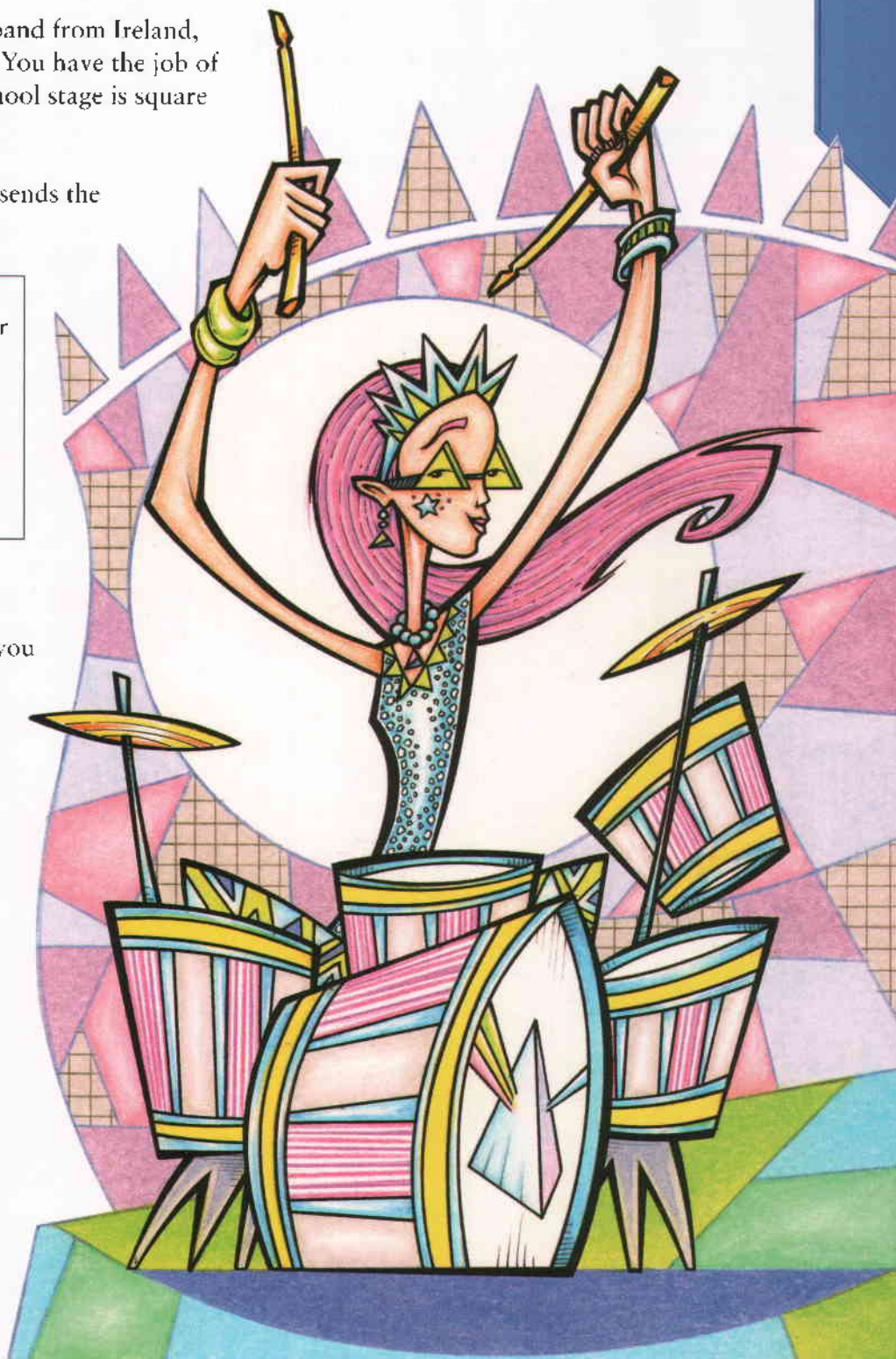
Do for the drummer:

- build a raised rectangular platform
- pack with something to muffle vibrations
- cover with black cloth
- decorate edges

Thanks

P.S. drummer likes silver

1. Design the platform.
2. Decide what materials you will need to build it. Calculate the amount of each material.
3. Make a model of the drummer's platform.
4. Use a diagram to show your complete plan and where you will place the platform on the school stage. Use words, pictures, and numbers to justify your response.



Chapters 5–8 Review

Chapter 5 Fractions, Decimals, and Percents

1. Klaus scored 35 out of 50 on his geography test, and 30 out of 40 on his science test.
 - a) What was Klaus's score on each test as a percent?
 - b) On which test did Klaus do better?
2. Three friends are comparing their progress on a science project.



- a) Write the progress of each student as a fraction.
 - b) Who is the closest to being finished? Explain.
 - c) Can you order estimates in the same way as exact values? Discuss.
3. On a very hot day, Jackie's dog, Bowzer, runs 9 laps around his backyard, instead of his usual 12. What percent of his daily workout does Bowzer *not* complete?

4. Alina and Kristoff had to answer 20 multiple-choice questions for a driver-training test. Their scores are given as percents.

Alina 90%
Kristoff 75%

To pass, you must get 16 out of 20 correct answers. Who passed the test? Describe your method.

Chapter 6 Patterning

5. Copy and complete each pattern by replacing each ■ with the appropriate value.
 - a) 6, ■, 14, ■ (addition sequence)
 - b) 45, ■, 23, ■ (subtraction sequence)
 - c) 7, ■, 28, ■ (multiplication sequence)
 - d) ■, 64, ■, 16 (division sequence)
6. Pennies can be arranged to make triangle shapes, as shown.



- a) How many pennies do you need to make the next triangle shape in this pattern? Explain your reasoning.
 - b) How many pennies would you need for the tenth triangle shape in the pattern? for the fortieth?
7. a) Plot the points given in the table. Describe the pattern.
b) What is the next point in the pattern?

x	y
0	3
1	4
2	5
3	6
4	7

8. a) Copy and complete this table.

Number of Jugs of Water	Volume in Litres
1	4
2	8
3	12
4	
5	

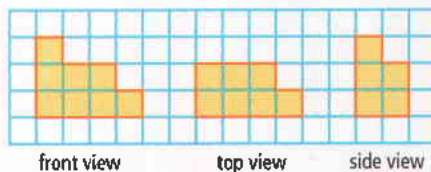
- b) Give a pattern rule for the volume of water.
 c) Write a variable expression for the volume, in litres, in n jugs of water.
 e) Use your expression or your pattern rule to find the volume of water in 25 jugs.

Chapter 7 Exponents

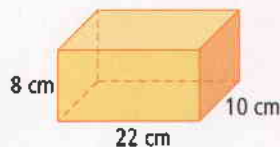
9. Write each expression as a power.
 a) $3 \times 3 \times 3 \times 3$ b) $8 \times 8 \times 8$
10. Find the area of a square that has each perimeter.
 a) 60 cm b) 26 m
11. Evaluate.
 a) $\sqrt{25}$ b) $\sqrt{49}$ c) $\sqrt{900}$
12. Write these expressions in order from the one with the greatest value to the one with the least value.
 3^3 33 $\sqrt{169}$ 1^{13} 13^2
13. Zoltan is tiling his kitchen floor. How many 25 cm by 25 cm square tiles does he need
 a) to cover a 1 m by 1 m square?
 b) to cover an area of 9 m^2 ?
14. Estimate the total number of words spoken in your school in one day.

Chapter 8 Three-Dimensional Geometry and Measurement

15. What closed three-dimensional figure am I?
 Sketch and name one object that fits each description.
 a) All my faces are rectangles.
 b) Two of my faces are flat, the other is curved.
 c) I have four faces.
 d) I have six congruent faces.
16. The diagrams show the front view, top view, and side view of a three-dimensional object. Sketch the object.



17. a) Calculate the surface area of the tissue box shown.



- b) What is the volume of the box?
18. Adam's favourite kind of cookie is sold in boxes of two different sizes.
 A: measures 12 cm by 12 cm by 15 cm, costs \$3
 B: measures 10 cm by 16 cm by 18 cm, costs \$5
 a) Which box is the better buy? What assumption did you have to make?
 b) Draw a net for each box.
 c) Calculate the surface area of each box. Which box is the more efficient design? Explain.

Data Management and Probability

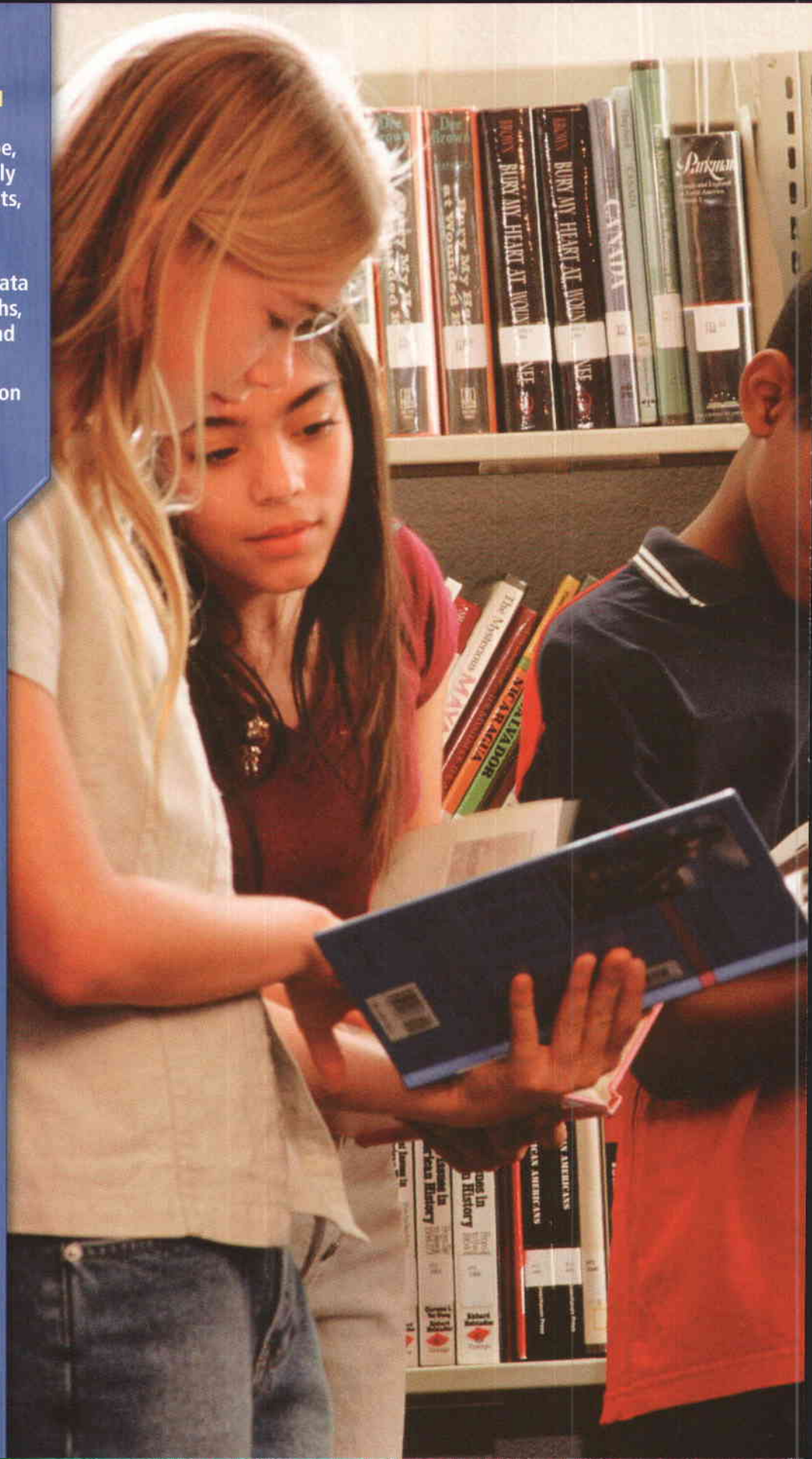
- Collect, organize, describe, and interpret data on tally charts, stem-and-leaf plots, and frequency tables.
- Use symbols, titles, and labels when displaying data on bar graphs, pictographs, and circle graphs with and without technology.
- Read and interpret data on bar graphs, pictographs, and circle graphs.
- Search databases for information and interpret the numerical data.
- Explore with technology to find the best presentation of data.
- Understand the difference between a spreadsheet and a database.

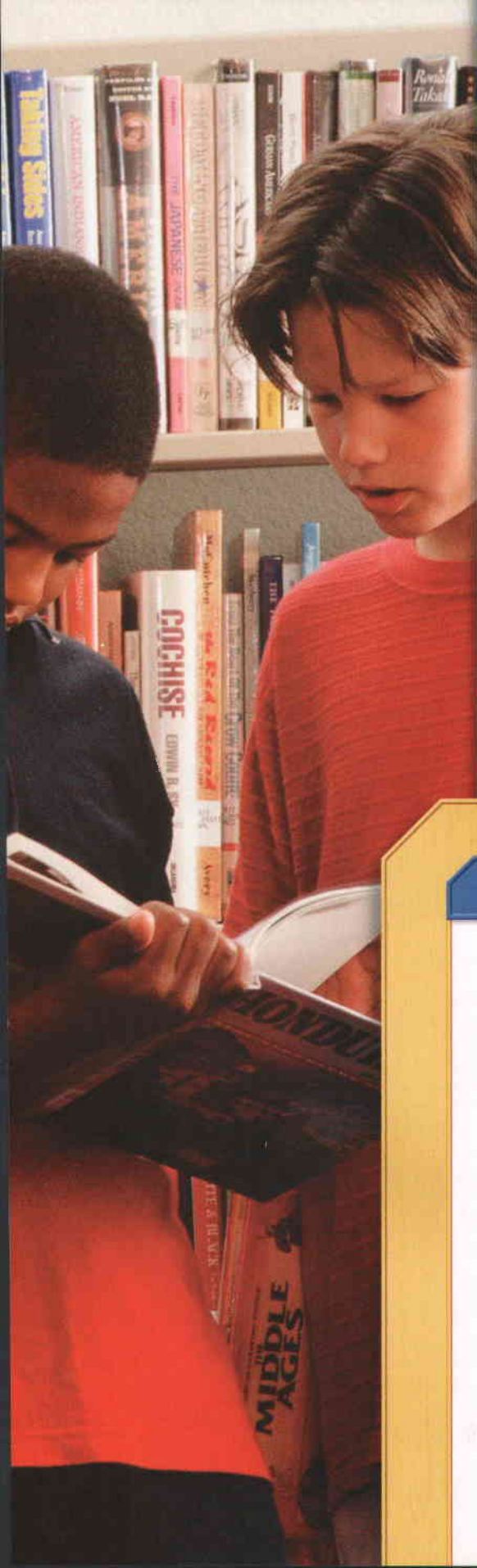
Number Sense and Numeration

- Solve problems that involve converting between fractions, decimals, and percents.

Key Words

primary data
frequency table
secondary data
stem-and-leaf plot
circle graph
database
spreadsheet
pie chart





Data Management: Collection and Display

What types of books do you like to read? Do you have a favourite author? What types of magazines do you like? What features of these magazines do you like?

Collecting and organizing this kind of information can help publishers, advertisers, and writers sell their work. In this chapter, you will learn a variety of ways to organize data and assess which type of display is best for presenting the data.

Chapter Problem

You are the publisher of a new magazine for students in grades 7 to 9. You are planning the first issue. Your editor has surveyed several grade 7 students. The results of the survey are shown.

Topic	Tally
Global issues	
Entertainment	
Health and fitness	
People and careers	
Sports	
Technology	

How could you organize and display the data?

How might the data help you plan your first issue?

Tally Charts

A tally chart is a table used to record experimental or survey data. In the tally chart shown, 8 people picked hockey as their favourite sport.

Favourite Sport	Tally
Hockey	
Football	
Baseball	
Basketball	
Golf	

Use the Favourite Sport tally chart to answer questions 1 and 2.

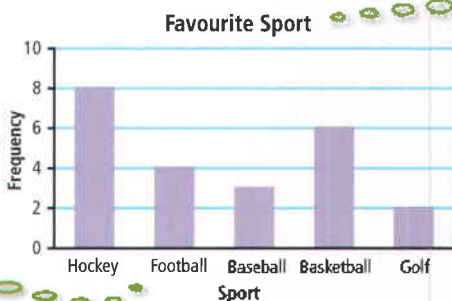
- How many people picked football?
 - How many people picked basketball?
 - Which sport is the least popular? How many people picked it?
- How many people were surveyed about their favourite sport?
- Survey 20 students about their favourite sport. Make up a tally chart to show the data.

Bar Graphs and Pictographs

This bar graph displays numeric data from the Favourite Sport tally chart. The height of a bar is equal to the total for that category.

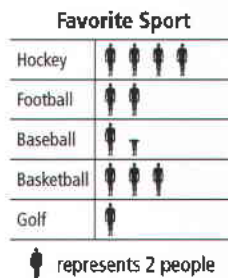
Label the vertical axis and the horizontal axis.

The bars are evenly spaced and of equal width.



Include a title for the graph.

This pictograph displays the same data by using a symbol that is related to the data. The symbols can be interpreted to give the total for each category.



4. Use the Favourite Sport bar graph and pictograph to answer these questions.
- Which sport is the most popular?
 - Which sport is the least popular?
 - How many more people chose hockey than football?
 - Explain how each graph shows the answers to parts a), b), and c).

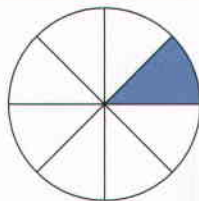
5. A group of young teens identified their favourite flavour of ice cream. Draw a bar graph and a pictograph to show the data.

Flavour	Number
Chocolate	5
Butterscotch	8
Cookies and cream	10
Mint chocolate chip	6
Other	4

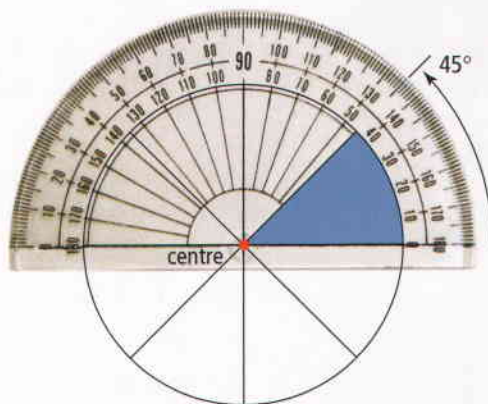
Simple Circle Diagrams and Angles

A fraction can be represented by a circle diagram.

For example, $\frac{1}{8}$ can be shown by shading one-eighth of a circle.

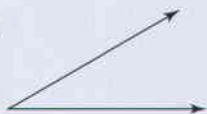


You can use a protractor to measure the size of an angle inside a circle. The angle shown measures 45° .

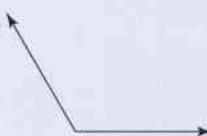


6. Use a protractor to measure each angle.

a)



b)



7. Use a ruler and a protractor to draw an angle with each measure.

a) 40° b) 90° c) 150°

8. Draw a circle diagram to represent each set of fractions.

a) $\frac{1}{4}, \frac{3}{4}$

b) $\frac{1}{3}, \frac{2}{3}$

9. For each circle diagram in question 8, measure the size of the angle that represents the smallest fraction.

9.1

Collect and Organize Data

Focus on...

- tally charts and frequency tables
- bar graphs and pictographs



School dances can be lots of fun, especially if the right kind of music is played. Data from a survey are often used to make informed decisions like this.

primary data

- data you collect yourself, such as from a survey

The results from Anand's survey provided **primary data**. What question might Natalie ask to collect primary data this year?

Discover the Math

How can you organize data that you collect?

Example 1: Use a Frequency Table to Draw a Bar Graph

frequency table

- a table that shows the count, or frequency, for each survey choice or experimental outcome

- Organize the data using a **frequency table**.
- Draw a bar graph to show the data.
- How can this information help Natalie choose music for the school dances?

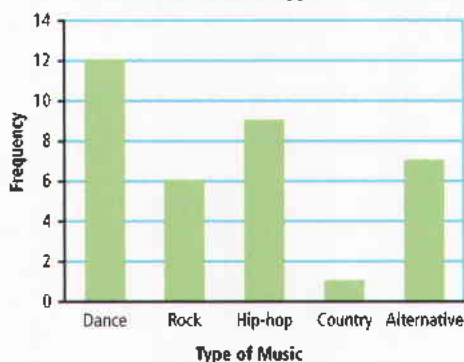
Type of Music	Tally
Dance	### ##
Rock	###
Hip-hop	###
Country	
Alternative	###

Solution

Type of Music	Tally	Frequency
Dance	### ##	12
Rock	###	6
Hip-hop	###	9
Country		1
Alternative	###	7

Write the total number of tallies here. This is the frequency.

b) Students' Favourite Type of Music



c) Dance music is the most popular. Country is not very popular. Natalie should choose mostly dance songs. She might include a mix of hip-hop, alternative, and rock songs.

Example 2: Use a Frequency Table to Draw a Pictograph

In a wildlife study, researchers recorded the population of rabbits in a certain field over time. They collected primary data.

A newspaper reporter found the data on the Internet. She used the **secondary data** in a story about the rabbits.

- a)** Draw a pictograph to show the data.
- b)** Describe at least one advantage and one disadvantage of using a pictograph for the data.

Hop into May

Researchers say there are more rabbits in May than...

secondary data

- data obtained from someone else, such as in published research

Rabbit Population

Month	Frequency
January	10
February	20
March	35
April	50
May	87
June	63

Literacy Connections



Primary and Secondary Data

How can you tell the difference between the two?

Primary data is information you collected by surveying people or counting things.

Secondary data is information someone else collected. You may read or hear about it.

Solution

a) Use a rabbit symbol. Let one  symbol represent 10 rabbits. Divide by 10 to find the number of  symbols to use for each value.

+	-
<ul style="list-style-type: none"> • rabbit symbol makes graph more interesting • reader sees information is about rabbits 	<ul style="list-style-type: none"> • difficult to accurately read some of the populations

Rabbit Population



Key Ideas

- Primary data consist of information you collect by surveying or counting.
- Secondary data consist of information obtained from other sources.
- Tally charts and frequency tables are useful for recording data.
- A bar graph compares the frequencies of different parts of a data set.
- A pictograph also shows frequencies. Pictographs are visually appealing, but may not represent the data precisely.

Communicate the Ideas

1. What type of data is each person collecting? Explain your choices.



2. Describe the information shown in the table. Is this a frequency table? Explain why or why not.

Favourite Car	Tally
Convertible	HHH II
Sport utility vehicle	HHH I
Sports car	HHH HHH
Minivan	II
Truck	HHH II

3. Use a plus/minus chart to list one advantage and one disadvantage of using each of the following to display data.

- a) bar graph b) pictograph

	+	-
Bar graph		
Pictograph		

Check Your Understanding

Practise

For help with questions 4 to 9, refer to Example 1.

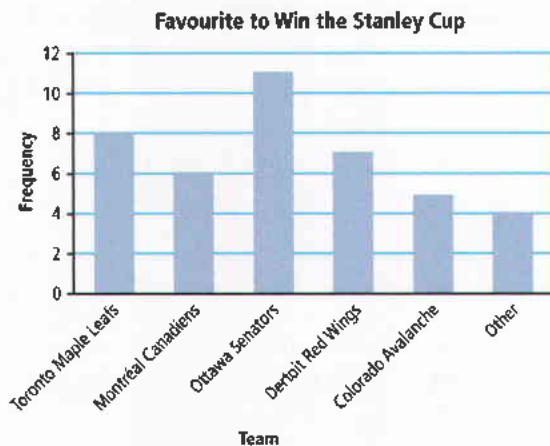
4. Make a frequency table for the data.

Favourite Animal	Tally
Cat	### I
Dog	### II
Horse	###
Rabbit	### III

5. Make a frequency table for the data.

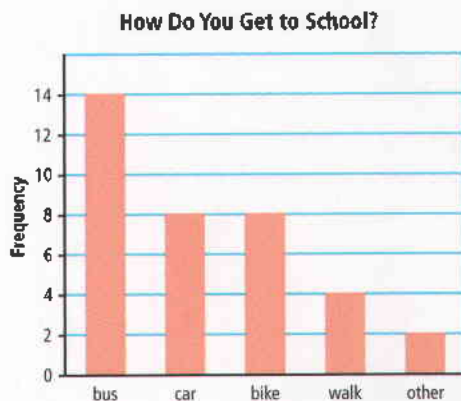
Favourite Insect	Tally
Butterfly	### ###
Spider	###
Fly	I
Ant	###

6. “Who will win the Stanley Cup this year?”
When a number of hockey fans were asked this question, they responded as shown.



- a) Based on the data, who is the favourite to win the Cup?
b) Make a frequency table for the data.
c) How many people were surveyed?

7. a) How many methods of getting to school are shown in the bar graph?
b) Make a frequency table for the data.



8. Draw a bar graph for the data.

Ice Cream	Tally	Frequency
Chocolate	### III	8
Strawberry	### I	6
Cookies and cream	### ###	10
Bubble gum	###	4
Vanilla	##	2

9. A juice company conducted a taste test among young teenagers to find their favourite flavours.

Juice	Tally	Frequency
Apple	###	
Orange	### I	
Strawberry-kiwi	###	
Citrus surprise	### III	
Crazy berry	### ###	

- a) Copy and complete the frequency table.
b) Display the data using a bar graph.
c) What is the most popular flavour?
d) What is the least popular flavour?
e) How many teens took the taste test?

For help with questions 10 to 12, refer to Example 2.

10. The pictograph shows the most popular costume types at Talia's party.

Costume	Number of People
Pirate	
Monster	
Super-hero	
Movie/pop star	
Other	

represents 2 people

- a) How many friends dressed up as pirates?
 b) How many friends dressed up as movie or pop stars?
 c) Make a frequency table for the data.
 d) How many people attended the party?
11. Draw a pictograph for the data.

Ice Cream	Tally	Frequency
Chocolate	HHH	8
Strawberry	HHH	6
Cookies and cream	HHH HHH	10
Bubble gum		4
Vanilla		2

12. Points for the teams in a recreational soccer league are shown.

Team	Points
Dizzy Dogs	50
Big Red Machine	45
Toe-Tappers	30
Lawn Mowers	58
Inter-Nets	22

- a) Draw a pictograph to show the data.
 b) Explain how you decided how many points each symbol should represent.
 c) The top three teams advance to the playoffs. Identify these teams.

13. Classify each of the following as primary data or secondary data.
- a) Randy conducts a survey about sports.
 b) Kuzana researches the bald eagle population of Ontario using resources in the school library.
 c) Jordan measures the height of each student in his classroom.
 d) Sarah looks up hockey statistics on the Internet.

Apply

14. a) Survey ten friends about their favourite kind of music. Use a tally chart to record their responses.
 b) Draw a graph of the results.
 c) What does the graph tell you about the music your friends prefer?

Making Connections

You worked with probability in Chapter 4.

15. When you roll a number cube, what number is most likely to turn up? Suppose you roll a number cube 50 times and display the results using a bar graph.



- a) Predict what the graph would look like. Describe and sketch your prediction.
 b) Carry out the experiment. Record your results in a frequency table.
 c) Draw a bar graph or pictograph to show your results.
 d) Compare your results with your prediction. Explain any differences that you see.

- 16.** Look at question 15. What do you think will happen if you roll the number cube 150 more times?
- Collect secondary data from three friends. Draw a bar graph to show data for all 200 trials.
 - Compare this graph with the one in question 15c). Describe what you notice.
 - Do any numbers have a higher probability of turning up? Use the results of this experiment to explain your answer.
- 17. a)** Pose a question on a topic of interest to you that you are likely to find secondary data on. Some examples are professional sports, health, and celebrity information.
- Search the Internet, a library, or other sources to find data. Record the source of your data.
 - Display the data using a bar graph or a pictograph.
 - Explain why you chose the type of graph that you did.

Chapter Problem

- 18.** What magazine is read by the most grade 7 students at your school?
- Design a survey.
 - Try to get at least 20 responses. Use a frequency table to organize your results.
 - Create a graph to display the data.
 - What can you say about the magazines read by students at your school based on the information you collected?
- 19.** Write an e-mail or a letter to a friend that missed class, describing the difference between primary data and secondary data. Support your explanation with examples.



- 20. a)** Design a simple survey on a topic of interest to you.
- Conduct the survey with at least 10 friends, classmates, or family members. Use a table to record your results.
 - Display your data using a bar graph.
 - Display your data using a pictograph.
 - Which graph displays the data more effectively? Explain why.

Extend

- 21.** Clive's boss has been nagging him to keep a tidier desk. One day Clive spilled coffee on an important graph he had been working on. He did not have a backup copy of the graph on his computer.



That night at home, Clive found the original frequency table that he had used to draw the graph. Unfortunately, Clive's dog ate part of it.

Region	Sales (\$1000s)
Ontario	20
Québec	15
Atlantic provinces	
Western provinces	
Territories	
TOTAL	71

Use the information that Clive found to reconstruct the frequency table and graph.

9.2

Focus on...

- stem-and-leaf plots

Stem-and-Leaf Plots

Canadian heroes like Manon Rheume and Hayley Wickenheiser are partly responsible for the increasing interest in Canadian women's hockey. As the game becomes more popular, the amount of data increases. How can you organize the data you collect about *your* sports heroes?

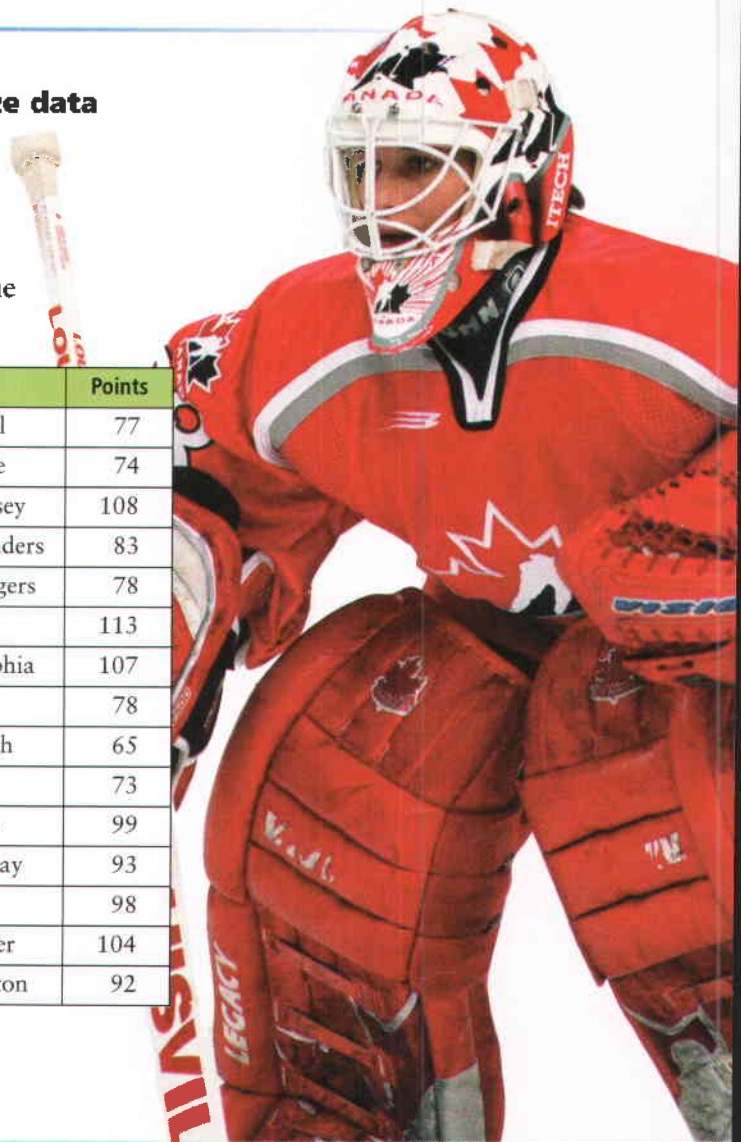


Discover the Math

How can you reorganize data into numeric groups?

The table shows the final regular season standings in the National Hockey League (NHL) for a recent year.

Team	Points	Team	Points
Anaheim	95	Montréal	77
Atlanta	74	Nashville	74
Boston	87	New Jersey	108
Buffalo	72	NY Islanders	83
Calgary	75	NY Rangers	78
Carolina	61	Ottawa	113
Chicago	79	Philadelphia	107
Colorado	105	Phoenix	78
Columbus	69	Pittsburgh	65
Dallas	111	San Jose	73
Detroit	110	St. Louis	99
Edmonton	92	Tampa Bay	93
Florida	70	Toronto	98
Los Angeles	78	Vancouver	104
Minnesota	95	Washington	92



1. Explain how the data values in the table are organized.
2. a) Which team had the greatest point total?
b) Which team had the least point total?
c) Which team had the fifth greatest point total?
d) Describe how you found your answers.
3. a) How many teams had points in the 60s? List the scores.
b) How many teams had points in the 70s? List the scores.
c) How many teams had points in the 80s? List the scores.
d) How many teams had points in the 90s? List the scores.
4. **Reflect** In what ways might you organize data to help you find numerical information?

Example 1: Read and Interpret a Stem-and-Leaf Plot

A **stem-and-leaf plot** arranges data into groups of increasing order. The following stem-and-leaf plot shows the NHL data from the Discover.

Stem (tens)	Leaf (ones)
6	1 5 9
7	0 2 3 4 4 5 7 8 8 8 9
8	3 7
9	2 2 3 5 5 8 9
10	4 5 7 8
11	0 1 3

For this data set, the stems represent the tens digit. The leaves represent the ones digit.

stem-and-leaf plot

- a way of organizing numerical data by representing part of each number as a stem and the other part of the number as a leaf

- a) How many teams scored in the 60s? What were their point totals?
- b) What stem contains the most data?
- c) What was the most common point total?

Solution

a)

Stem (tens)	Leaf (ones)
6	1 5 9

↑ Stem ↑ Leaves



60 is 6×10 .
I should look at the row for stem 6.

There are 3 leaves. Three teams have points in the 60s. The point totals are 61, 65, and 69.

- b) Stem 7 has the most data. It has 11 leaves.
- c) There are three 8s in stem 7.

7 | 0 2 3 4 4 5 7 8 8 8 9

These represent 78s. So, 78 is the most common total.

Example 2: Create a Stem-and-Leaf Plot

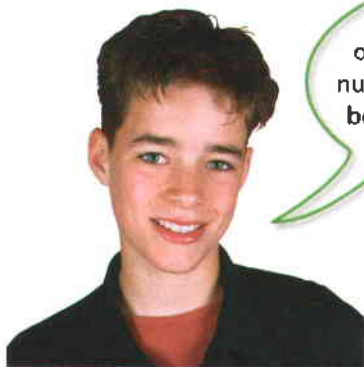
Here are scores for a figure skating competition.

6.2 7.1 5.7 9.3 7.7 6.4 4.7 5.2 7.0 8.5
7.5 5.3 8.2 9.6 7.1 7.3 5.9 6.7 8.8 6.3
5.5 6.8 7.9 7.1 4.6 6.0 8.1 8.4 7.6 6.2

- Create a stem-and-leaf plot to show the data.
- How many skaters scored in the 5s?
- How many skaters scored in the 8s or higher?
- In what numeric group did more skaters score than any other?
- What does the shape of the stem-and-leaf plot tell you about the overall scores?

Solution

a)



I will use the ones digit for the stem. The numbers after the decimal will be the leaves. First, I'll group all the 4s together.

Stem (ones)	Leaf (tenths)
4	6 7
5	5 3 7 9 2
6	2 8 4 0 7 3 2
7	5 1 9 1 7 1 3 0 6
8	2 1 4 8 5
9	3 6

My leaves are not in order. I'll rewrite to show them in order.

Stem (ones)	Leaf (tenths)
4	6 7
5	2 3 5 7 9
6	0 2 2 3 4 7 8
7	0 1 1 1 3 5 6 7 9
8	1 2 4 5 8
9	3 6

Scoring in the 5s means a score from 5.0 to 5.9. I should look at stem 5.

Look at stem 8 and stem 9. Count the total number of leaves in these two stems.

- Five skaters scored in the 5s.
- Seven skaters scored in the 8s or higher.
- Stem 7 has the most leaves. Nine skaters scored in the 7s.

- e) The shape of the plot shows a large number of scores clustered near the middle. There are fewer scores at the high and low ends. This suggests that most skaters scored in the 5 to 8 range.

Stem (ones)	Leaf (tenths)
4	6 7
5	2 3 5 7 9
6	0 2 2 3 4 7 8
7	0 1 1 1 3 5 6 7 9
8	1 2 4 5 8
9	3 6

Key Ideas

- A stem-and-leaf plot is used to organize and order large sets of numeric data.
- To create a stem-and-leaf plot, organize the data into groups (stems). Then, order the data within each stem and write the leaves.

Communicate the Ideas

- The stem-and-leaf plot shows people's ages.
 - Describe how the stem and leaf of a value are related.
 - What ages are shown?
- What's wrong? The prices for 6 pairs of running shoes, rounded to the nearest dollar, are \$69, \$74, \$79, \$79, \$85, and \$89. Describe the error. Explain how to fix it.

Stem (tens)	Leaf (ones)
1	1 2 5
2	3 6
3	0 4

Stem (tens)	Leaf (ones)
6	9
7	4 9
8	5 9

Check Your Understanding

Practise

For help with questions 3 to 5, refer to Example 1.

- How many stems are in the plot?
 - Which stems have two leaves?
 - Which stem has the most data?
 - List the scores shown.

Stem (tens)	Leaf (ones)
1	4 7
2	0 3 3 8
3	1 5
4	2

- The stem-and-leaf plot shows the average monthly rainfall, in millimetres, for a particular city.
 - What amounts of rainfall are represented in stem 7?
 - How many rainfall measurements are recorded in the stem-and-leaf plot?

Stem (tens)	Leaf (ones)
2	8
3	2
4	8
5	4
6	0
7	2 5
8	5 6 8
9	3

5. The stem-and-leaf plot shows the ages of people at a family picnic.
- | Stem
(tens) | Leaf
(ones) |
|----------------|----------------|
| 0 | 7 9 |
| 1 | 1 3 3 7 |
| 2 | |
| 3 | 6 7 8 |
| 4 | 1 2 2 |
| 5 | 8 9 |
| 6 | 2 3 |
- a) How many children are under 10? How old are they?
- b) How many teenagers are there? How old are they?
- c) Four grandparents are present. How old do you think they are? Explain.

For help with questions 6 to 9, refer to Example 2.

6. Complete the stem-and-leaf plot by organizing the leaves in increasing order.
- | Stem
(tens) | Leaf
(ones) |
|----------------|----------------|
| 1 | 1 6 2 |
| 2 | 7 0 3 |
| 3 | 8 5 1 |
| 4 | 3 2 7 3 |
| 5 | 6 9 |

7. Organize the following data using a stem-and-leaf plot.
- 10 21 32 47 12 22 34 47
14 25 36 18
- a) What will the stem values represent?
- b) What will the leaf values represent?
- c) Create the stem-and-leaf plot.
- d) Write one question about your stem-and-leaf plot. Answer your question.

8. a) Organize the following scores using a stem-and-leaf plot.
- 22 36 18 24 41 55 15 27 22 38
44 32 36 22 13 45 50 20 37 40
- b) Write one question about your stem-and-leaf plot. Answer your question.

9. Victor rounded his grocery bills to the nearest dollar. During the past two months, he spent \$67, \$81, \$73, \$64, \$66, \$73, \$82, and \$59.
- a) Organize the data using a stem-and-leaf plot.
- b) What is Victor's most common grocery bill amount?
- c) How much has Victor spent on groceries over the past two months?

Apply

10. A group of students wrote a test. Their scores, out of 50, are shown.

Stem (tens)	Leaf (ones)
1	8 9
2	2 4 5 8 8 9
3	0 1 2 2 3 6 8 8 8 9
4	2 3 5 5 8
5	0

- a) How many students scored in the 40s? What were their scores?
- b) In which stem did more students score than any other?
- c) Did any student write a perfect test? Explain.
- d) How many students scored below 50%? What were their scores?
11. The numbers of wins for the teams in a minor baseball league are 45, 61, 57, 90, 88, 80, 95, 49, 53, 80, 85, 92, 103, 85, 77, 73, 85, 68, 74, and 82.
- a) Organize the data using a stem-and-leaf plot.
- b) How many teams won more than 90 games?
- c) What was the most common number of wins?

- 12. a)** Collect age data from 15 to 20 family members, friends, and acquaintances.
b) Create a stem-and-leaf plot to show the data.
- 13.** The masses, in grams, of samples of a particular chemical are 1.2, 1.3, 0.8, 1.0, 0.8, 1.4, 0.7, and 1.0.
- a)** Create a stem-and-leaf plot for the data.
b) Explain what the stems and leaves represent.
c) What is the difference between the greatest mass and the least mass?



14. The times for 50-m sprinters are shown in a stem-and-leaf plot.

Stem	Leaf
6	8 3 2
7	0 1 1 3 5

- a)** Organize the plot.
b) What do the stems and leaves represent? Justify your answer.
c) Explain five things that the data set tells you.

Extend

- 15.** Weekly payroll data values for a small company are given. The stem shows the hundreds digit and the tens digit.

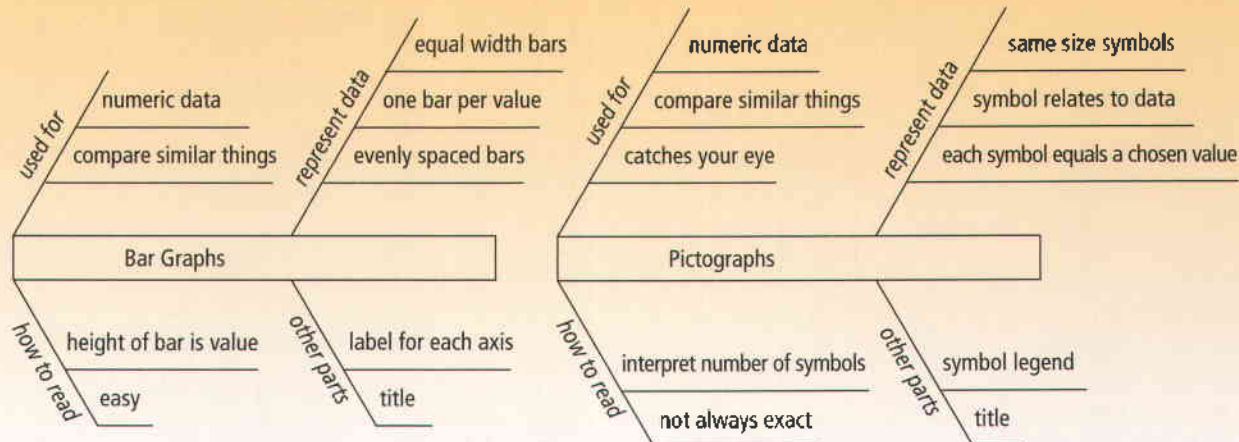
Stem	Leaf
28	0 5
29	0 0 0 4 8
30	5 5
31	8
32	
33	
34	8

- a)** How many employees work for the company? Justify your response.
b) What is the most common weekly wage?
c) What is the highest weekly wage?
d) What is the company's total weekly payroll expense? Explain how you found this.
e) The boss wishes to hire a very experienced and talented worker. What is the highest weekly wage the boss can offer the worker without exceeding the payroll budget of \$3640? If the new worker accepts, will that person be the highest paid employee? Explain.

Literacy Connections

Prepare to Write

Use a fishbone organizer to help you plan paragraph answers. The examples shown describe bar graphs and pictographs. Use the point-form information to write two paragraphs.

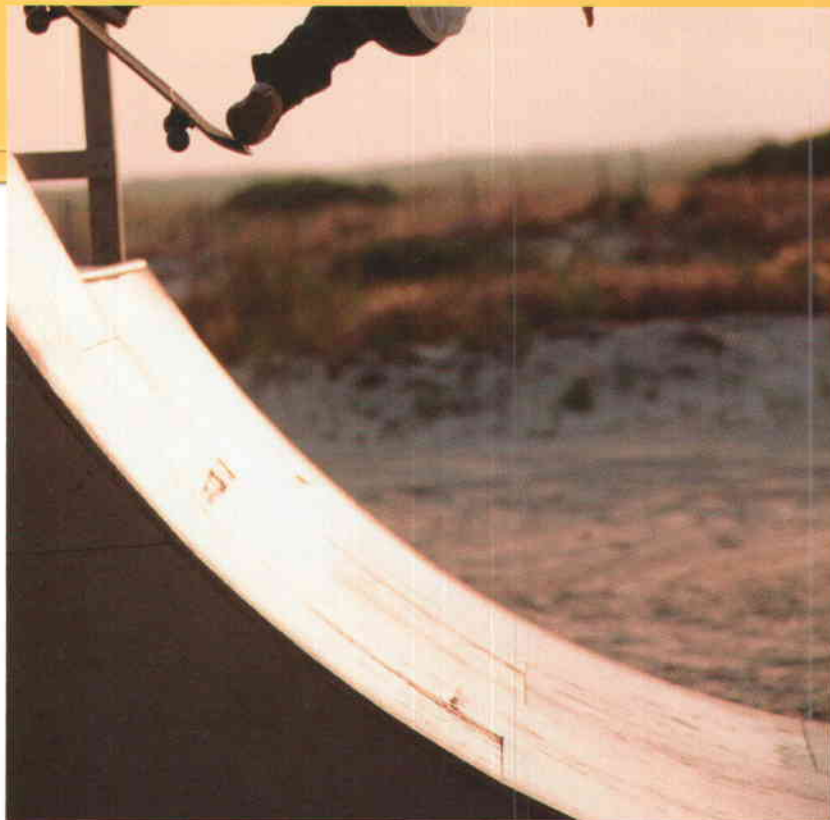


9.3

Focus on...
• circle graphs

Circle Graphs

Three friends agree to build a quarter-pipe skateboard ramp for the owner of a small sports store. The friends decide to divide the job into three individual tasks. The store owner wants to pay the group \$240. How can you show how much each person should be paid?



Discover the Math

Materials

- grid paper
- manipulatives (e.g., coloured counters)
- compasses
- protractor
- pencil crayons

circle graph

- a graph that uses sections of a circle to show how a data set is divided into parts

How can you show how part of a data set compares to the whole data set?

- The friends decide to divide the money according to the number of hours they each worked.
 - Draw a circle to represent the whole project.
 - Using estimation, divide the circle into three pieces to show each person's contribution to the project.
 - Explain how you decided on the size of each person's section.
- How much do you think each person should get paid?
 - Explain how you decided on these amounts.
- How can a **circle graph** help you show how parts of a whole are related?

Worker	Hours Worked
Fumio	2
Suriya	4
Justin	6

Example 1: Draw a Circle Graph

A group of 100 grade 7 students were surveyed to find their favourite hobbies.

Draw a circle graph to display the data.

Hobby	Number of People
Read books/comics	25
Watch television	50
Surf the Internet	10
Play video games	15

Solution

Method 1: Work With the Fractions You Know

Hobby	Number of People	Fraction	Size of Section
Read books/comics	25	$\frac{25}{100}$	This is the same as one quarter. I can show one quarter of a circle.
Watch television	50	$\frac{50}{100}$	This is the same as one half. I can show half the circle.

Making Connections

For help with converting fractions to decimals, refer to Chapter 5.

Method 2: Calculate Section Angles You Do Not Know

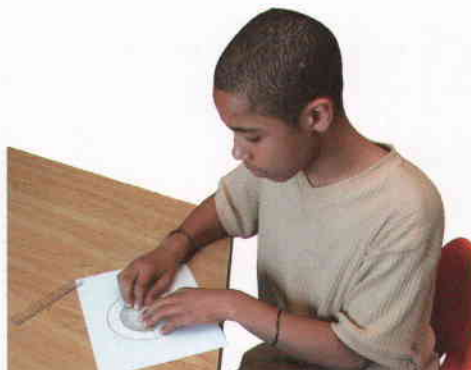
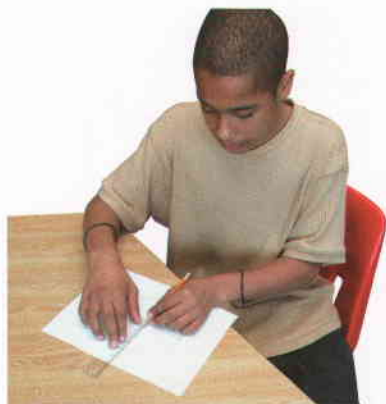
To do this:

- express each category as a fraction
- write as a decimal
- since there are 360° in a circle, multiply each decimal value by 360 to find the section angle

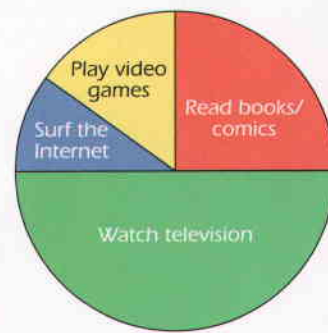
Hobby	Number of People	Fraction	Decimal	Section Angle
Surf the Internet	10	$\frac{10}{100}$	$10 \div 100 = 0.1$	$0.1 \times 360^\circ = 36^\circ$
Play video games	15	$\frac{15}{100}$	$15 \div 100 = 0.15$	$0.15 \times 360^\circ = 54^\circ$

Use the decimal shown on your calculator to complete the calculation for the section angle.

Draw a circle. Use a protractor to measure each section.



Favourite Hobbies of Grade 7 Students



Shade or colour the sections if you want to. Then, label the sections and write a title.

Example 2: Read and Interpret a Circle Graph

The circle graph shows what Mary does with her monthly earnings from baby-sitting.

- Which is Mary's greatest monthly expense? How much is it?
- How much does Mary spend on movies and CDs each month?
- How much of Mary's monthly budget goes to "Other" expenses?

Solution

- a)** The largest section is "Lunches and Snacks."

Find 30% of \$200.

$$\begin{aligned} 30\% \text{ of } \$200 &= 0.3 \times \$200 \\ &= \$60 \end{aligned}$$

Mary spends \$60 per month on lunches and snacks.

- b)** She spends 20% on movies and 15% on CDs.

Movies:

$$\begin{aligned} 20\% \text{ of } \$200 &= 0.2 \times \$200 \\ &= \$40 \end{aligned}$$

CDs:

$$\begin{aligned} 15\% \text{ of } \$200 &= 0.15 \times \$200 \\ &= \$30 \end{aligned}$$

Movies and CDs:

$$\$40 + \$30 = \$70$$

Mary spends a total of \$70 per month on movies and CDs.

- c)** First, find the percent for this category.

Find the sum of all expenses except "Other."

$$30\% + 20\% + 20\% + 15\% + 10\% = 95\%$$

The circle must total 100%. Subtract.

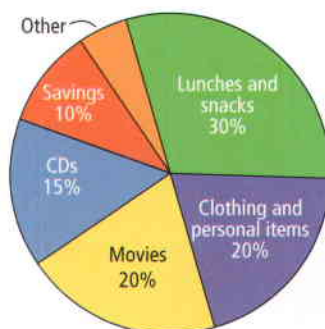
$$100\% - 95\% = 5\%$$

Mary spends 5% of her monthly earnings on "Other" expenses.

$$\begin{aligned} 5\% \text{ of } \$200 &= 0.05 \times 200 \\ &= 10 \end{aligned}$$

Mary spends \$10 per month on "Other" expenses.

Mary's Monthly Budget: \$200



Making Connections

For help with finding a percent of a number, refer to Chapter 5.

It would be faster to add 20% and 15%. If I calculate $0.35 \times \$200$, I get \$70.

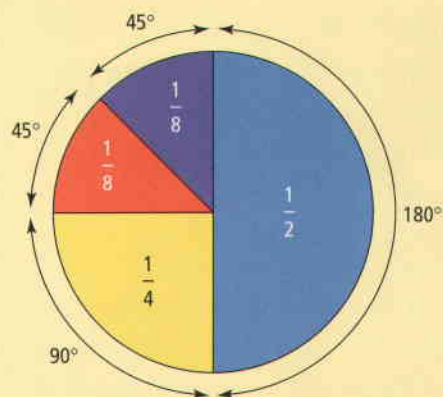


Strategies

What other method might you use to find this answer?

Key Ideas

- A circle graph shows how each part of a data set compares to the whole.
- To create a circle graph, use the following steps:
 - To create a circle graph using simple fractions:
 - Express each category as a fraction of the whole.
 - Show each fraction of the circle.
 - To create a circle graph with more difficult fractions:
 - Express each fraction as a decimal.
 - Use the decimal to find the size of each section angle.
 - Use a protractor to measure and draw each section angle.
- Add section labels and a title to the circle graph. You may wish to shade the sections.



Communicate the Ideas

1. Compare a circle graph with a bar graph. Use an organizer to help you. Describe one advantage and one disadvantage of each type of graph.
2. Which set of data can best be presented in a circle graph? Explain.

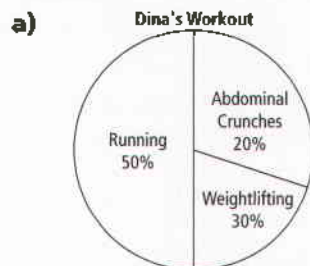
a)

Favourite Pet	
Cat	35%
Dog	45%
Bird	15%
Rabbit	10%
Other	5%

b)

Score out of 10	
Quiz 1	8
Quiz 2	7
Quiz 3	9
Quiz 4	8
Quiz 5	10

3. What is wrong with each circle graph? Describe how it can be corrected.



Check Your Understanding

Practise

For help with questions 4 to 7, refer to Example 1.

4. Draw a circle graph for each set of section angles.
- $120^\circ, 120^\circ, 120^\circ$
 - $90^\circ, 90^\circ, 90^\circ, 90^\circ$
 - $60^\circ, 60^\circ, 60^\circ, 60^\circ, 60^\circ, 60^\circ$
5. Draw a circle graph for each set of section angles.
- $60^\circ, 60^\circ, 60^\circ, 45^\circ, 45^\circ, 90^\circ$
 - $30^\circ, 30^\circ, 30^\circ, 135^\circ, 90^\circ, 45^\circ$
6. In a grade 7 class, there are 12 boys and 20 girls. How could you find the section angles to represent the data?
- Copy and complete the table of calculations.

Grade 7 Students	Number	Fraction	Decimal	Section Angle
Boys	12			
Girls	20			
TOTAL				

- Draw a circle graph to show the data.

7. Three friends worked together on a science project. Melissa worked 5 h, Zach worked 4 h, and Cecilia worked 3 h. How could you find the section angles to represent the data?

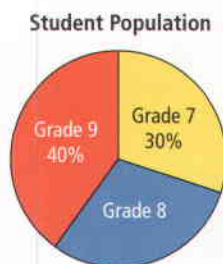
- Copy and complete the table of calculations.

Person	Hours	Fraction	Decimal	Section Angle
Melissa	5			
Zach	4			
Cecilia	3			
TOTAL				

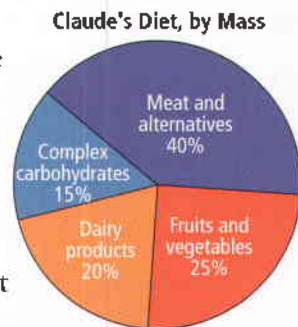
- Draw a circle graph to show the data.

For help with questions 8 and 9, refer to Example 2.

8. a) Which student group is the largest?
b) What percent of the student population is in grade 8?



9. a) What type of food does Claude eat the most?
b) If Claude consumes 1000 g of food per day, how much of it is meat and alternatives?
c) How much of the 1000 g of food per day is dairy products?



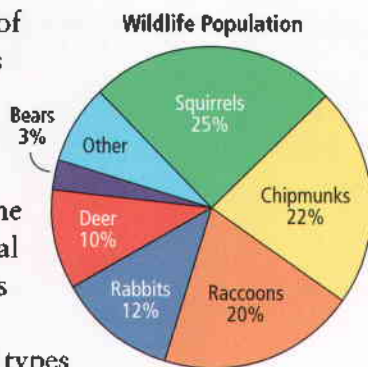
Apply

10. A group of hockey fans were surveyed to identify their favourite Canadian team in the NHL.

Team	Number of People
Calgary Flames	15
Edmonton Oilers	15
Montréal Canadiens	8
Ottawa Senators	5
Toronto Maple Leafs	7
Vancouver Canucks	10

- Estimate the size of the three largest sections of a circle graph for the data.
- Draw a circle graph. How close were your estimates?
- This survey was conducted in only one province. Which province do you think it was? Explain why you think so.

- 11. a)** Which type of mammal has the greatest population? What fraction of the total mammal population is this?



- b)** Which three types of mammal account for about $\frac{2}{3}$ of the total mammal population?

- 13.** Draw a circle graph that shows the probability of rolling each number (1 to 6) on a standard number cube.



- 14. a)** Search newspapers, magazines, textbooks, or the Internet. Find an example of a circle graph that is used to show data.
- b)** Briefly describe what the graph shows.
- c)** Comment on the graph's effectiveness in
- catching the reader's attention
 - making a point
- d)** Pose and answer two questions about the data that can be answered by looking at the graph.

Chapter Problem

- 12.** How many of the pages in your favourite magazine are advertisements?
- Count all the pages in your favourite magazine with ads.
 - Count all the pages without ads.
 - What other method might you use to find the number of pages without ads?
 - Create a circle graph that shows the number of pages with ads and without ads.
 - How could this information be useful to a magazine publisher?

Extend

- 15. a)** Search various media, such as the Internet, magazines, or newspapers, for a bar graph that can also be represented as a circle graph. Create a circle graph to represent the same data.
- b)** Describe any advantages either graph has over the other.
- 16. a)** Find a circle graph and transform it into a bar graph.
- b)** Comment on the advantages of each graph.

Making Connections

Materials

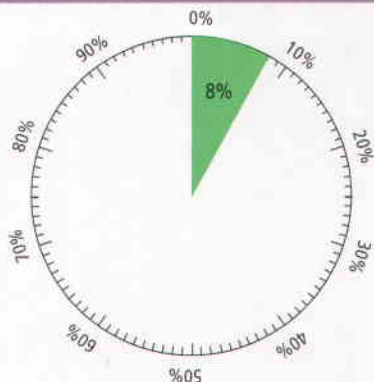
- BLM 9.3A Percent Circle

Percent Circle

A percent circle is a circle that is divided into 100 equal sections. Each section represents 1%. For example, to show 8%, colour in 8 sections of the percent circle.

How can you use a percent circle to draw a circle graph?

Using a percent circle, create a circle graph to display the data in Example 1. Compare your graph with the graph that was made. Are they the same? Explain.



9.4

Use Databases to Find Data

Focus on...
• databases

What programs start at 6 P.M.? On what channels? You could use this **database** to find out. You could check all the program choices for a certain time slot. You could also find out when and on what channel your favourite show is.

Thursday, July 12	TV Schedule
6:00 (8)(3)(V) NEWS	8:00 (2) STAR LURK Datum discovers the emotion of sadness after the Captain confines him to the brig for getting Rigelian muffin crumbs in the ship's navigation controls.
6:30 (K) LETTUCE TALK Radishes—the next big thing or just another vegetable?	8:30 (7) THUNDER PIGEONS Sally cuts up Commander Bob's credit cards.
(S) SUPERDUDE Superdude gets audited and it looks like he's going to be fighting crime from the inside for a while.	9:00 (A) MOVIE—Camp Afoul Teens run afoul of a mad wounded chicken in an abandoned summer camp.
7:00 (Y) ACQUAINTANCES Russ dyes his hair blue. Mona discovers a quantum singularity in her purse.	9:30 (A) THEY WEREN'T ALL GOOD TIMES Wally falls asleep in his parked car and rolls into a van bound for Mexico.
7:30 (S) CRAFT TIME Build your own tool shed from discarded cereal boxes.	

database

- an organized collection of information
- often stored electronically

Discover the Math

Materials

- TECH 9.4A Accessing the CANSIM Database

Optional

- TECH 9.4B Printing Graphs From CANSIM

Alternative

- BLM 9.4A Databases Without Technology

How can you use a database to find data?

Statistics Canada has created a giant database that includes information about Canada's people and resources. The database is called CANSIM: the Canadian Socio-economic Information Management System. E-STAT is the Internet link between you and the CANSIM database.

1. Go to www.mcgrawhill.ca/links/math7 and follow the links to access E-STAT. Click **English**.



On the next Web page, click **Accept** and **enter**.

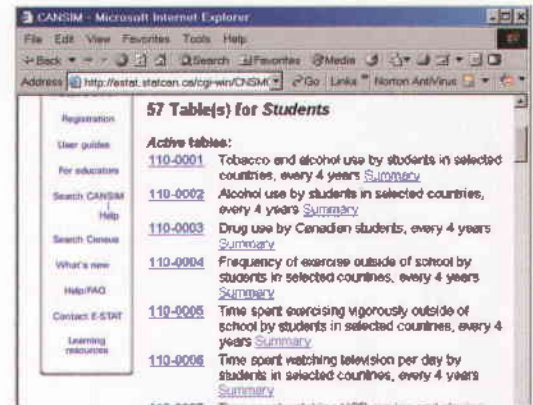
2. Find data about adolescent students from the Table of Contents Web page.

Under **People**, select **Education**.

On the next Web page, click **Data**.

Then, under CANSIM, select **Students**.

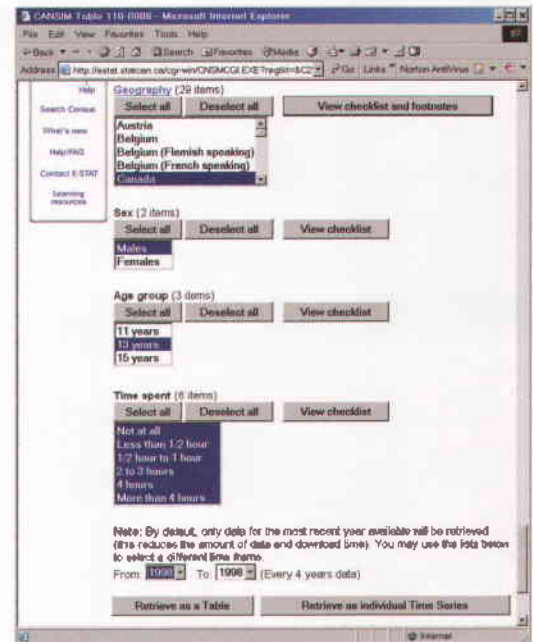
3. Look at the list of tables. Briefly describe some of the information that looks interesting to you.



4. Find data about the television-watching habits of Canadian youths.

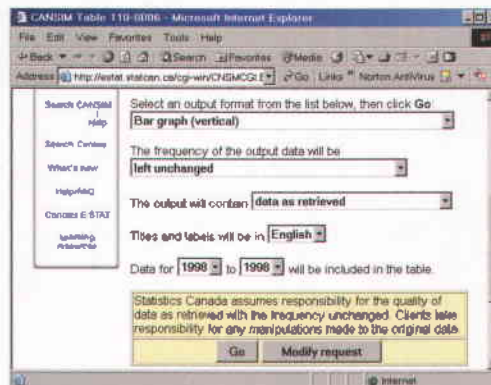
Select table 110-0006.

Next, select Canada, Males or Females, and 13 years. Then, for Time spent, click Select all. Finally, click Retrieve as a Table.



5. Select a type of graph to display the data.

Choose Bar graph (vertical), Bar graph (horizontal), or Pie chart. Then, click Go.



Technology Tip

- To compare graphs, you could copy and paste them into a word-processing document.

6. a) Look at the data. What does the graph tell you?
 b) Use the Internet browser's **Back** button to return to the previous page. Select a different type of graph to present the data, and click **Go**. Does this new graph give any more information? Which type of graph do you prefer? Why?
7. Go back and look at the data for the opposite gender. Are there any noticeable differences between the television viewing habits of boys and girls? Explain.
8. a) Does age make a difference? Go back and look at data for 11-year-olds and 15-year-olds. Compare the three age categories.
 b) Make notes on anything interesting that you see.
 c) How do the habits of Canadian youths compare to those from other countries?
9. **Reflect** Explain how to access data in the CANSIM database.

I can use this skill on my science project. I'll type "earthquakes, Richter scale" into a Web search engine. I'll look for interesting data. How can you use what you learned here?



Key Ideas

- A database is an organized collection of information.
- Electronic databases allow you to select specific information or sort the information in different ways.

Communicate the Ideas

1. Describe three things you discovered about the television-watching habits of Canadian youths.
2. Identify three topics that you can use E-STAT to find data for.
3. What databases do you use regularly? Classify them as print or electronic databases.

The screenshot shows the E-STAT website interface. The browser title is "E-STAT - Table of contents (Preview) - Microsoft Internet Explorer". The address bar shows "http://estat.statcan.ca/content/eng/1...". The page content is organized into a table of contents with the following sections:

Table of contents	
Preview	Articles Data
Economy	
Business enterprises	Prices and price indexes
Communications	Science and technology
Construction	Service industries
Manufacturing	Trade
National accounts	Transport and warehousing
Land and Resources	
Agriculture	Environment
Energy	Primary industries
People	
Arts, culture and recreation	Personal finance and household finance
Education	Population and demographics
Health	Social statistics
Labour	Travel and tourism

Check Your Understanding

Practise

- Telephone directories are print databases. Check out the white pages for your community.
 - How are the listings organized?
 - What information does each listing provide?
- Look at the yellow pages for your community.
 - How are the listings organized?
 - What information does each listing provide?



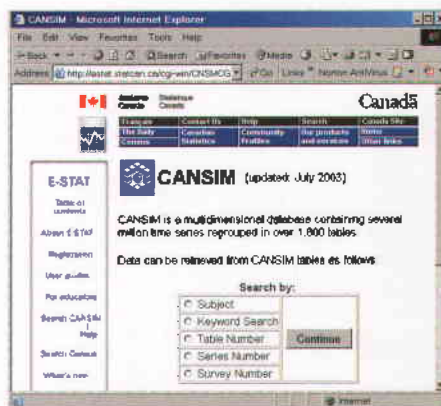
Go to www.mcgrawhill.ca/links/math7 and follow the links to access E-STAT.

Use E-STAT for questions 6 to 8.

- Use E-STAT to find data that describe the weekly exercise habits of Canadian youths. Follow these steps:
 - From the **People** section of the Table of Contents Web page, select **Arts, culture, and recreation**.
 - On the next page, select **Data**.
 - Then, under CANSIM, select **Recreation**.
 - Finally, select table 110-0004.
 - On the Table 110-0004 Web page, what choices need to be selected to retrieve data on 13-year-old Canadian males?
 - Select your choices from part a). Click **Select all** for the **Frequency of exercise** choice. Next, click **Retrieve as a Table**.
 - Display the data in a bar graph or a pie chart. What does the graph tell you?
- Go back and select the same data as in question 6 for females.
 - Display the data in the same graph type as for question 6c). What does the graph tell you?
 - Are there any noticeable differences in the weekly exercise habits of boys and girls? Explain.

- Search CANSIM by subject.
 - Go to the Table of Contents page. Click **Search CANSIM** on the left side of the page.
 - Select **Subject**. Click **Continue**.
 - Select a topic that interests you.

Write a couple of sentences to describe your findings.



Apply



What music is popular today? Go to www.mcgrawhill.ca/links/math7 and follow the links to a music database.

Use this database for questions 9 to 11.

- Nielsen SoundScan gathers data on the most popular current songs. The chart shows the top 100 singles in Canada. It also lists the number of weeks each song has been on the chart, where the song ranked two weeks ago, and its ranking last week.
 - What are the top three songs today? How accurate was your prediction?
 - Pick any two songs from the chart. For each song, identify the name of the song, the artist, the number of weeks on the chart, and the current chart position.

10. Go back to the top of the Web page for question 9. From the **Top Albums: City** by **City** pull-down menu, select **Toronto**. A chart of the top 20 albums is displayed.

- Identify the song and artist that hold the number one spot.
- What chart position does this song hold on the national chart?
- From the **Top Albums: City by City** pull-down menu, select **Ottawa**. Answer parts a) and b) for this city.

11. Go back to the top of the Web page for question 9. From the **Other Charts** pull-down menu, select **Top 100 CD's of all time**.

- For each of the top three Canadian singles of all time, identify the title of the song, the artist, and the year it was produced.
- Scan the top 20 singles of all time. Copy and complete the frequency table.

	Tally	Frequency
Songs I recognize		
Artists I recognize		
Artists I have never heard of		

- Do the results in your table surprise you? Explain why or why not.
 - Few new artists appear on this list. Why do you think this is? Do you think this may change over time? Explain.
- 12.** Look at television listings for this week. Make up a plan to compare how two Canadian channels slot different types of programs from 6 P.M. to 10 P.M. What conclusions can you make? Hint: Canadian channels include CBC, CTV, CITY, and Global.



Go to www.mcgrawhill.ca/links/math7 and follow the links to an NHL database. Use this database for questions 13 and 14.

- 13.** The three fields at the top of the Web page allow you to access various statistics. Select the Most Current Season Entire League Skater Summary

Abbreviations Legend
GP = Games Played
G = Goals
A = Assists
PTS = Points
+/- = Plus/Minus Rating
PIMS = Penalties in Minutes
MINS = Minutes Played

- By selecting one of the headings, you can change the way the data set is organized. Identify the top three ranked players in goals, the top three in assists, and the top three in points.
 - What do the data values in the MINS/GP column tell you? Find the top three ranked players in this category. Explain what this tells you about their play.
- 14.** Go back to the top of the Web page for question 13. Change some of the field selections to explore data for other regular seasons, playoffs, or specific teams.
- Write two questions or problems that can be answered by looking at the data you found.
 - Answer your questions.
 - Trade with a partner and answer each other's questions. Check to make sure that you each found the same answers.



Which were the most watched TV shows last week? Go to www.mcgrawhill.ca/links/math7 and follow the links to a television ratings site. Use this Web site for question 15.

15. a) Click **Nielsen Top 10 Ratings** in the top right corner of the Web page. For each of the top three **Broadcast TV Programs**, list the name of the program, the rating (percent of households that watched the program), and the number of viewers.
- b) Go back one Web page. List the same data as in part a) but for the top three **Cable TV Programs**.
- c) How do you think Nielsen obtains its data?

Chapter Problem

16. Your school or public library probably uses a computerized database to store its book information. Ask for assistance from the librarian if you need it.
 - a) Pick the title of a book that you like or are interested in. Enter the title into the database and find the name of the author.
 - b) Enter the name of the author to find other books that he or she has written. How many titles are in this list?
 - c) Write down the names of two other books written by this author that you are interested in, or have not read.
 - d) Use the database to find out if these books are in the library.

17. Interview two adults about how databases are used in their workplace.

18. Use an organizer to make point-form notes about what you have learned about databases. Use your notes to plan a one-minute talk.

- Describe what a database is.
- Explain how a database is organized.
- Give examples of information you found in a database.



What kind of music is popular today? Go to www.mcgrawhill.ca/links/math7 and follow the links to a music database. Use this Web site for question 19.



19. Use the links to explore other parts of the music database.

- a) Describe two things that you found interesting.
- b) Write two questions or problems that can be answered using this database.
- c) Find the answers to your questions.
- d) Trade with a partner and answer each other's questions. Check your answers.

Extend

20. a) Search the Internet to find a database of information that interests you. Some possible topics are sports, entertainment, movies, and astronomy.
- b) Write three questions that can be answered by retrieving information from the database.
- c) Use the data to answer your questions.
- d) In a few sentences, briefly describe the database. Use examples to support your description.
- e) Display the data for one of your questions.

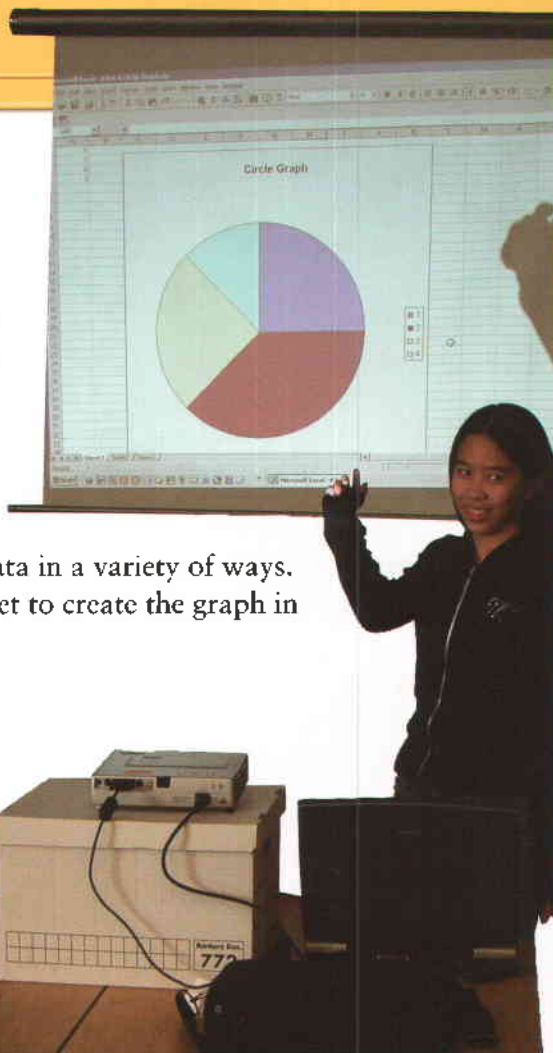
9.5

Focus on...
• spreadsheets

Use a Spreadsheet to Display Data

An effective presenter uses dynamic visuals to capture and hold an audience's attention. With the help of technology, you can quickly produce a number of different graphs that will add that professional touch to your presentation.

A **spreadsheet** allows you to enter data into a computer in organized rows and columns and then display the data in a variety of ways. How could you use a spreadsheet to create the graph in the photo?



spreadsheet

- a software tool for organizing and displaying numeric data
- software packages include AppleWorks, ClarisWorks, Microsoft® Excel, and Quattro® Pro

Materials

- TECH 9.5A Using AppleWorks 6.2

Optional

- TECH 9.5B Using AppleWorks 5.0
- TECH 9.5C Using Quattro® Pro 10
- TECH 9.5D Using Microsoft® Excel 2002

Alternative

- BLM 9.5A Spreadsheets Without Technology

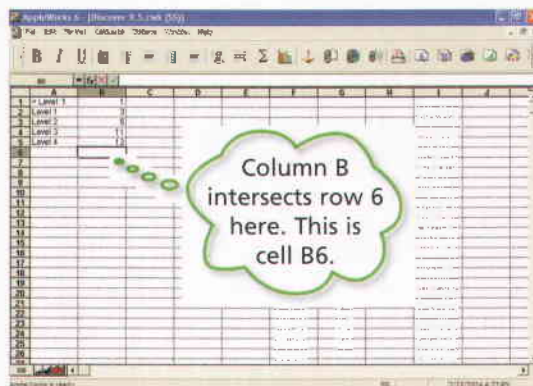
Discover the Math

How can you use a spreadsheet to display data?

The table shows the results of a math test.

Result	Number of Students
Below Level 1	1
Level 1	3
Level 2	5
Level 3	11
Level 4	12

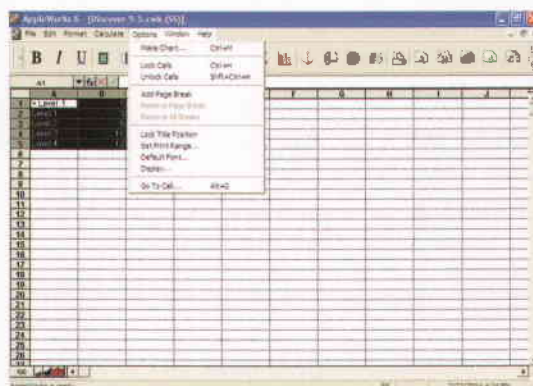
- Open a new spreadsheet document in AppleWorks 6.2.
 - Enter the categories and values, as shown. Click a cell. Type in the text or value. Press **Enter**.
 - What does “< Level 1” mean?



Technology Tip

- You can use the arrow keys or your mouse to move from one cell to another.

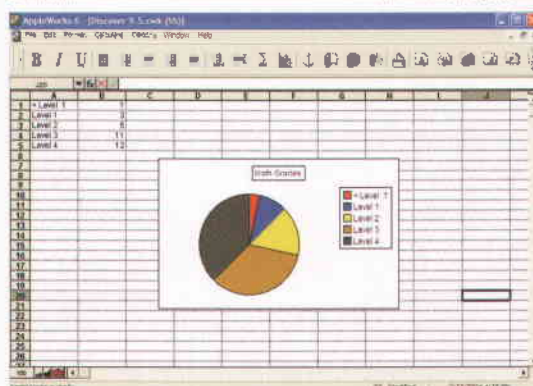
- Create a **pie chart** to show this set of data. Select the data set. Click cell A1 and drag to cell B5. From the Options Menu, select **Make Chart**. From the Chart Options Gallery list, select **Pie**. Click **OK**.



pie chart

- the same as a circle graph

Right click inside the pie chart and select **Chart Options...** from the pop-up menu. Click on the **Labels** tab. In the **Title** box, type **Math Grades**. Click **OK**.

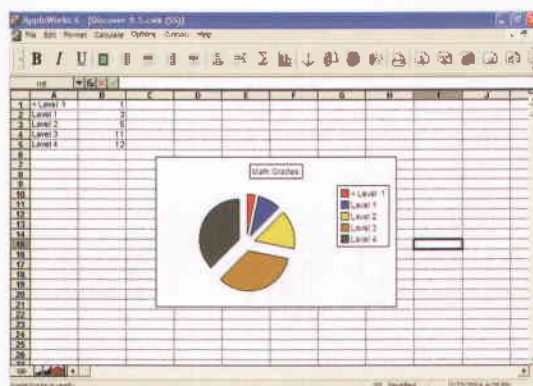


- Explode the pieces of the pie chart.

Right click inside the pie chart and select **Chart Options...** from the pop-up menu. Click on the **Series** tab.

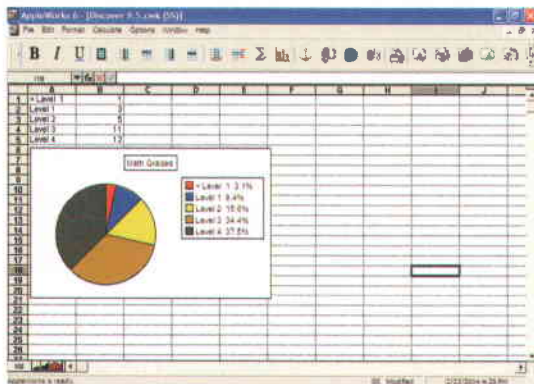
In the **Edit Series** box, select **All**.

In the **Display as area**, click **Explode slice**. Click **OK**.



4. a) Look at the pie chart. Estimate what percent of the students scored
 - at Level 3
 - below Level 4
 b) Right click the pie chart and select **Chart Options...** from the pop-up menu. Click on the **Series** tab. In the **Display as** area, unclick **Explode slice**. Click **Label Data** and **% in legend**. Click **OK**.
 c) Compare the percent values with your estimate in part a).
 d) Explain how a circle graph is useful for showing the comparison of part of a data set to its whole.

5. a) Click and drag the pie chart underneath the data.
 b) Right click on the pie chart. Experiment with the different formatting options available for the pie chart.



6. a) Experiment with different chart types, including vertical and horizontal bar graphs, line graphs, and any other types that look interesting. Right click the pie chart and select **Chart Options...** from the pop-up menu. From the **Gallery** tab, select a different type of chart. Click **OK**.
 b) Describe what each type of graph looks like. Use words and simple sketches.

7. a) Which type of graph do you think is the easiest to read? Explain why.
 b) Which type of graph did you find the most interesting? Explain why.
 c) Which type or types of graphs were not suitable for displaying the data? Explain why not.

8. **Reflect** List the various ways you can display data using a spreadsheet.

Technology Tip

- If, after you right click, you don't see the option you are looking for, move the cursor position. Try to click a clear spot.

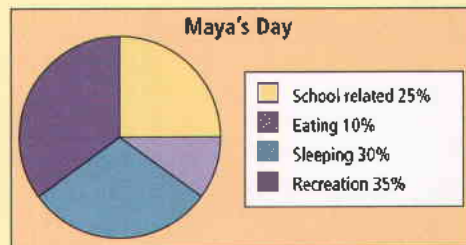
I want to graph some information for my geography project. I like the bar graph format that shows the bars in 3D. Maybe I'll use that.

What was your favourite graph type? How can you use it?"

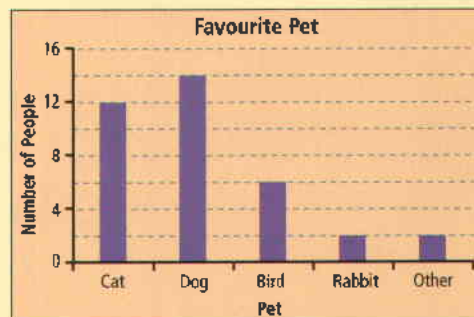


Key Ideas

- A spreadsheet is a software tool used to organize and display numeric data.
- A spreadsheet can be used to develop various types of graphs.
- The best choice of graph type depends on the nature of the data and the types of comparisons you wish to focus on.
 - Use a pie chart to show how each part of a data set compares to the whole or to show percents.



- Use a bar graph to show how different parts of a data set are related or to compare similar things.



Communicate the Ideas

1. What type of graph would you use to display each set of data? Explain why.

a)

School Population	
Grade 7	35%
Grade 8	30%
Grade 9	35%

b)

Hours Spent Reading	
Monday	2
Tuesday	3
Wednesday	3

2. a) Describe three different ways you can format a spreadsheet graph.

b) Identify advantages and disadvantages of using these different formats.

3. Who is right? Explain.



A spreadsheet and a database are the same thing.

They are not the same. I can search a database to find information. I use a spreadsheet to record and display numeric data.



Check Your Understanding

Practise

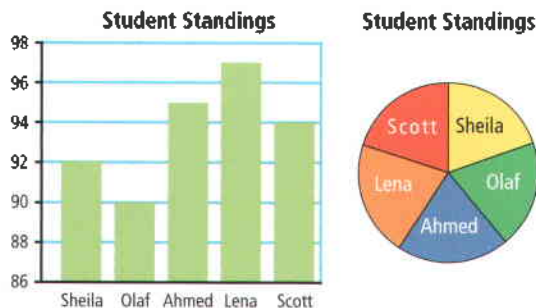
4. A soccer team has 12 wins, 8 losses, and 4 ties. The data set is displayed as a bar graph and a pie chart. Which graph do you prefer? Why?



5. Marks, in percent, for the five students competing for an academic scholarship are shown.

Student	Percent
Sheila	92
Olaf	90
Ahmed	95
Lena	97
Scott	94

The data set is displayed as a bar graph and a pie chart. Which graph clearly identifies the top students? Explain your answer.

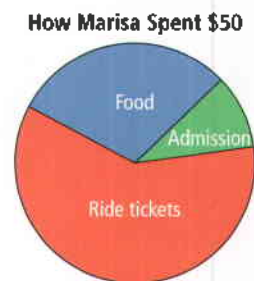
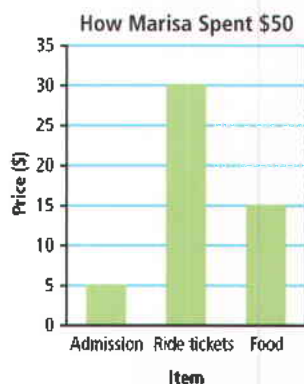


6. What is another name for a pie chart? Explain how you can remember both terms.

7. Marisa spent \$50 while at the local amusement park.

Item	Price (\$)
Admission	5
Ride tickets	30
Food	15

The data set is displayed as a bar graph and a pie chart. Which graph clearly identifies how Marisa spent her \$50? Explain your answer.



Apply

8. The table shows waterslide park ticket sales by age.

Age Group	Tickets
Under 4	50
4 to 60	225
Over 60	50

- Enter the data into a spreadsheet program.
- Create a graph.
- Explain your choice of graph in part b).