

Enlargements and Reductions

Focus on...

After this lesson, you will be able to...

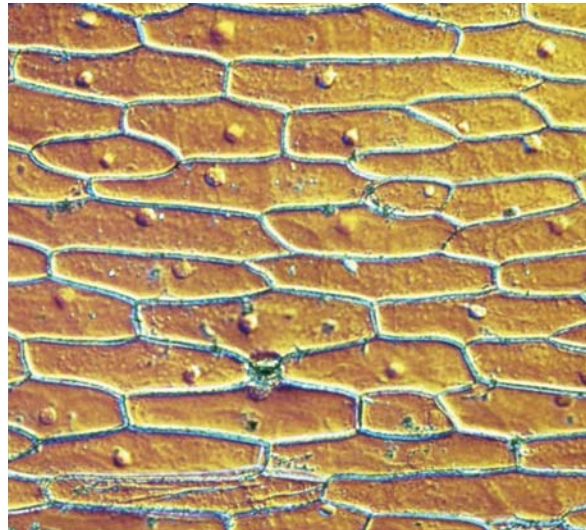
- identify enlargements and reductions, and interpret the scale factor
- draw enlargements and reductions to scale

Did You Know?

One of the most powerful microscopes used in high schools today can enlarge an object 1500 times.

A microscope magnifies objects that are too small to be seen by the naked eye. This picture shows an enlarged view of cells in onion skin.

To calculate the factor that the onion cells are magnified by, multiply the magnification of the eyepiece by the magnification of the objective lens. The objective lens is the lens you choose to look at the object with.



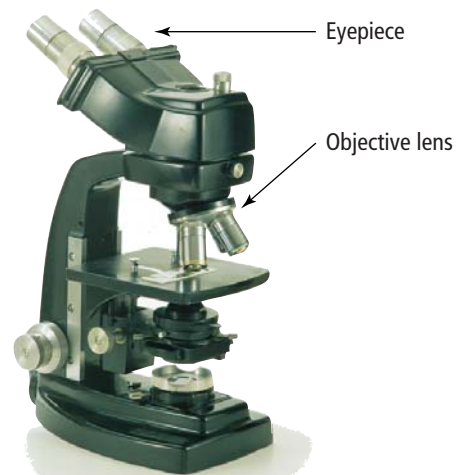
Magnification of eyepiece: 10x

Magnification of objective lens: 40x

Total magnification: $10 \times 40 = 400x$

The onion cells are enlarged by 400 times their original size.

How do you think the enlarged view is the same as the actual piece of onion skin? How is it different?

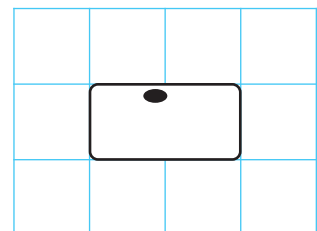


Materials

- centimetre grid paper
- tracing paper
- ruler

Explore How to Enlarge an Image

1. Brainstorm with a classmate how you might enlarge the onion cell. What different strategies can you develop?
2. Try out at least one of your strategies and draw an image that is twice as large as this onion cell. What will be the ratio of the lengths of the sides of the enlargement to the original?



3. Compare your diagram(s) with one of a classmate. Which strategy for making an **enlargement** do you prefer? Explain why.

Reflect and Check

4. a) What method might you use to check that the enlarged image is twice as large as the original? Try your method.
 b) How are the enlargement and the original the same? How are they different?

enlargement

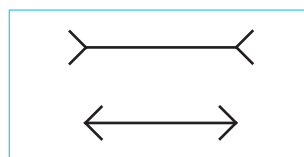
- an increase in the dimensions of an object by a constant factor
- can be 2-D or 3-D
- for example, each dimension of this enlargement is twice the length of the original



Link the Ideas

Example 1: Draw an Enlargement

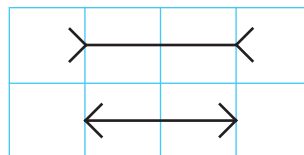
Draw a picture with dimensions that are twice as large as the original.



Solution

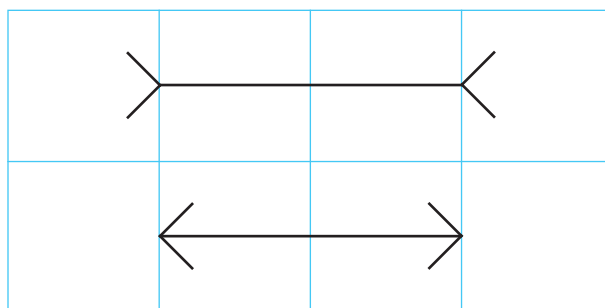
Method 1: Use Grid Paper

Trace the picture on centimetre grid paper.



How could you use 1-cm grid paper to draw the enlargement?

Draw the contents of each grid square into the corresponding region on a piece of 2-cm grid paper.

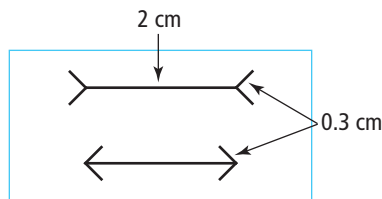


A map grid names the regions between grid lines. Try using a map grid to help copy the information. The first arrow has been drawn.

	A	B	C	D
1				
2				

Method 2: Use a Scale Factor

Measure the length of each line segment.



scale factor

- the constant factor by which all dimensions of an object are enlarged or reduced in a scale drawing
- the dimensions of this rectangle are multiplied by 3, so the scale factor is 3



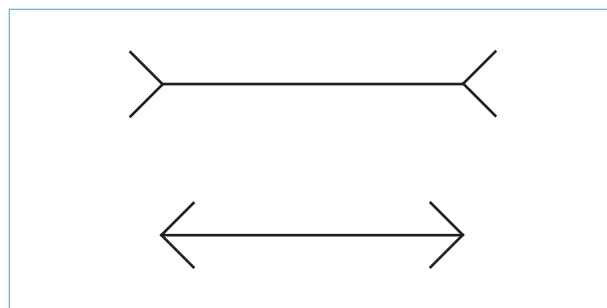
Multiply each measurement by a **scale factor** of 2.

$$2 \times 2 = 4$$

$$0.3 \times 2 = 0.6$$

The line lengths for the enlargement are 4 cm and 0.6 cm.

Use the new lengths to draw the enlargement.

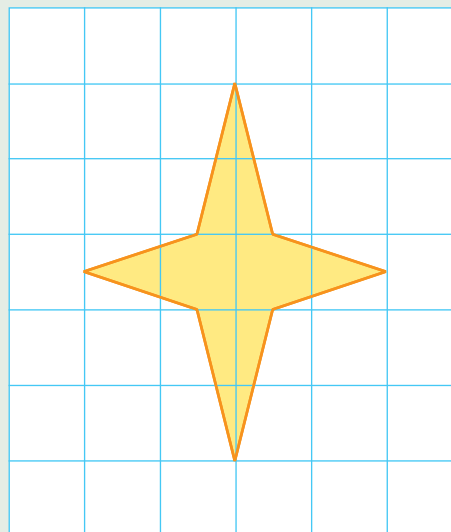


How do you know the scale factor is 2?

How else might you enlarge the picture?

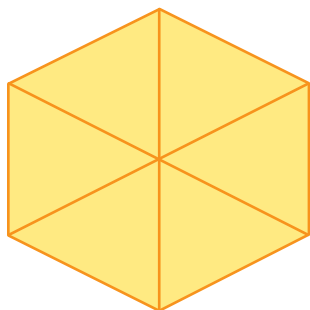
Show You Know

Use two methods for drawing a picture with dimensions three times as large as this original.



Example 2: Draw a Reduction

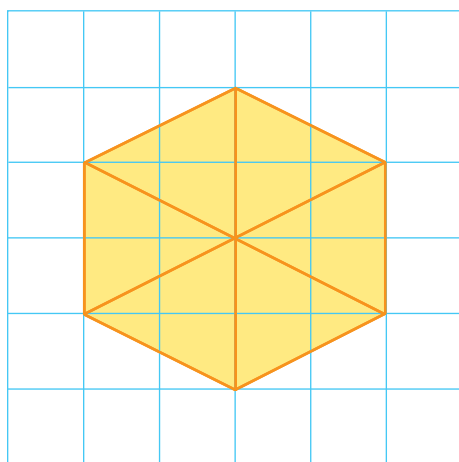
Draw a **reduction** that is half as large as the original.



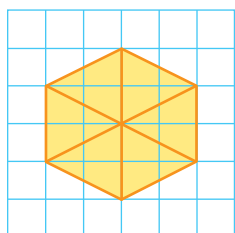
Solution

Method 1: Use Grid Paper

Trace the picture on centimetre grid paper.



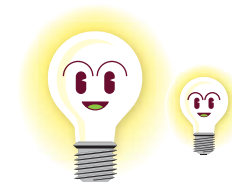
Draw the contents of each grid square into the corresponding area on a piece of 0.5-cm grid paper.



How could you use 2-cm grid paper and 1-cm grid paper to draw this reduction? What if you have only 1-cm grid paper?

reduction

- a decrease in the dimensions of an object by a constant factor
- can be 2-D or 3-D
- each dimension of this reduction is half the length of the original

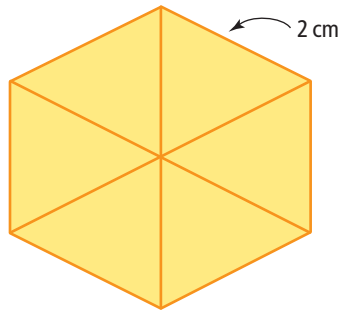


Method 2: Use a Scale Factor

Measure the length of each line segment.

What scale factor will you use? Explain why.

Tech Link
You can use a drawing program to enlarge or reduce an image using a scale factor. Or, you can drag an object to the size you want.



Multiply the length by 0.5.
 $2 \times 0.5 = 1$

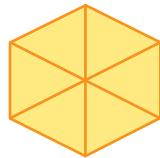
The scale factor indicates whether an object is enlarged or reduced. What does each statement tell you?

- a scale factor greater than 1
- a scale factor less than 1
- a scale factor equal to 1

The length of each line segment for the reduction is 1 cm.

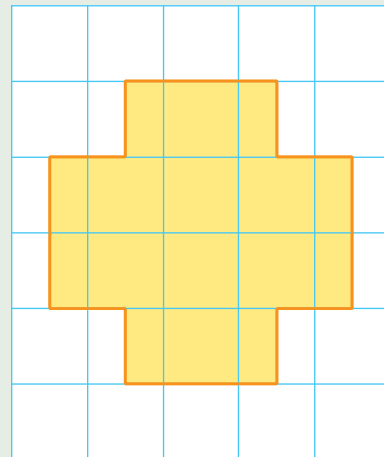
Use the new length of each line segment to draw the reduction.

Which method do you prefer for drawing a reduction? Explain.



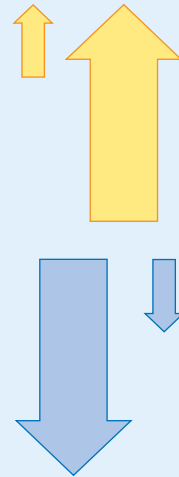
Show You Know

Use a method of your choice and a scale factor of 0.5 to draw a reduction of this shape.



Key Ideas

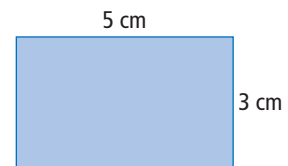
- An enlargement results in an image that is the same shape but proportionally larger than the original.
- A reduction results in an image that is the same shape but proportionally smaller than the original.
- The scale factor is the constant amount that all dimensions of an object are multiplied by to draw an enlargement or reduction.
 - A scale factor greater than 1 indicates an enlargement.
 - A scale factor less than 1 indicates a reduction.
- You can use grid paper and a scale factor to draw enlargements and reductions.



Check Your Understanding

Communicate the Ideas

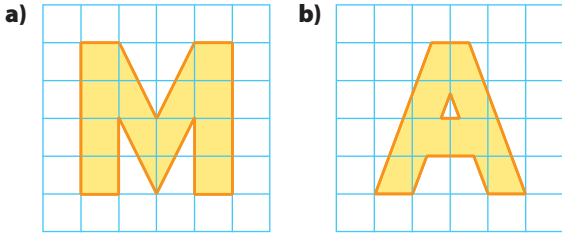
1. Jesse thinks many photographs in this student resource are reductions. Is he correct? Justify your reasoning.
2. Mary used a scale factor of 3 to enlarge a rectangle.
 $3 \times 3 = 9$
The length of each side for the enlargement is 9 cm.
Is she correct? If so, explain how you know. If she is incorrect, explain her mistake. Discuss your answer with a partner.
3. This logo was designed for a film club. Describe two different methods to enlarge the logo for a poster.



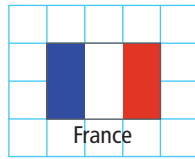
Practise

For help with #4 and #5, refer to Example 1 on pages 131–132.

4. Use a scale factor of 2 to enlarge each letter.

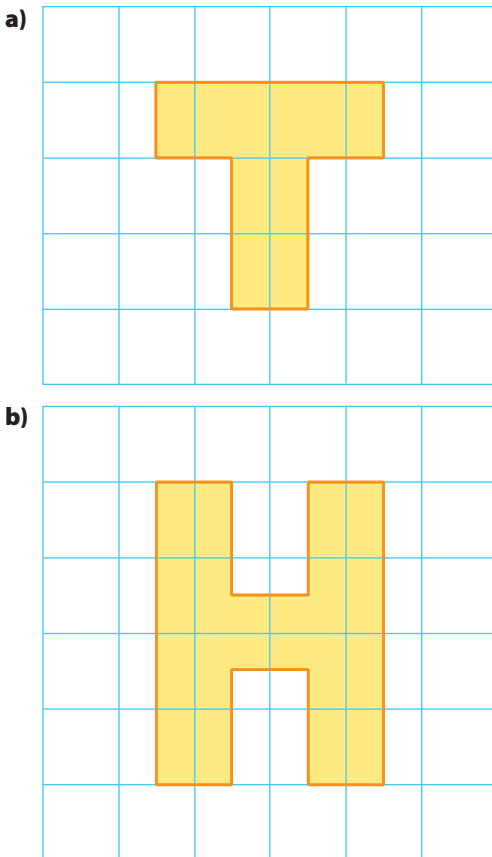


5. Draw an enlargement of the flag using a scale factor of 4.



For help with #6 to #8, refer to Example 2 on pages 133–134.

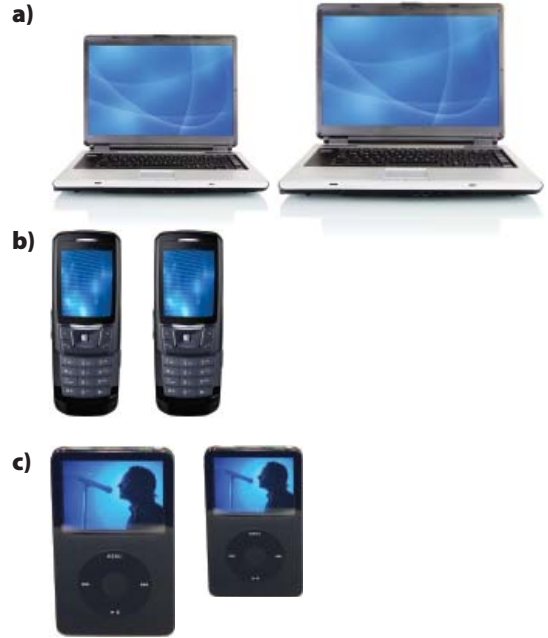
6. Use a scale factor of 0.5 to draw a reduction of each letter.



7. For the image on the right in each pair of pictures, indicate if the scale factor is

- greater than 1
- less than 1
- equal to 1

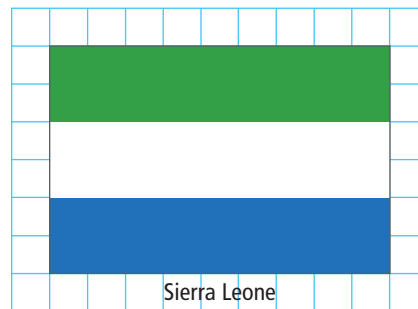
Explain how you know.



WWW Web Link

To explore enlargements and reductions of images graphically or numerically by using a scale factor, go to www.mathlinks9.ca and follow the links.

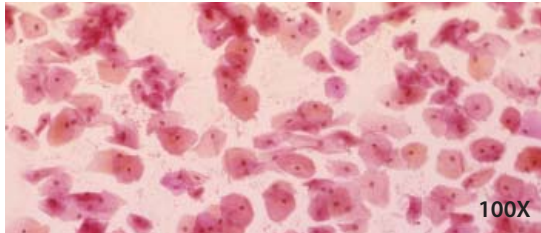
8. Draw an image of the flag using a scale factor of $\frac{1}{3}$.



Apply

9. Melissa is observing a slide of human cheek cells under the microscope.

- Is this an enlargement or a reduction? Explain your reasoning.
- What is the scale factor? Explain its meaning.



10. Hassan and Mia made posters for the *Festival du Voyageur*. What is the scale factor on Mia's poster compared to Hassan's poster? Explain your reasoning.



Hassan



Mia

Did You Know?

In 1969, the *Festival du Voyageur* was founded in Saint Boniface. The event has grown from three days held in Winnipeg's French Quarter to a ten-day, province-wide celebration every February. This festival celebrates the *joie de vivre* of the fur traders who established the Red River colony and the growing French-Canadian community in western Canada. The Festival encourages people to appreciate the beauty of winter by participating in historical and entertaining activities.



11. How can you determine if Figure B is a true reduction of Figure A?

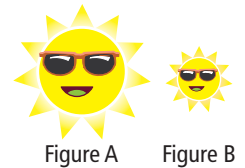


Figure A

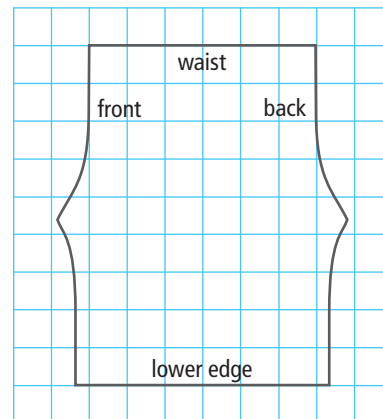
Figure B

12. The ratio of the length to the width of the Canadian flag is 2 : 1. Assume that you have a flag that is 9 cm wide.



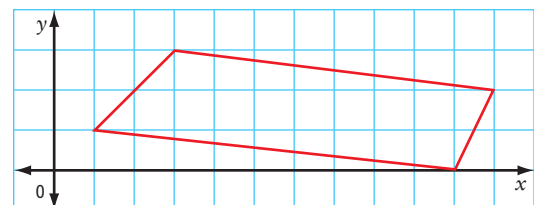
- What are the dimensions of a flag that has a scale factor of 3?
- What are the dimensions of a flag that has a scale factor of 0.5?

13. For the Heritage Fair, Chloe wants to sew miniature replicas of traditional hunting pants. The pattern piece below is for making pants. She wants to make three different sizes of the pants using the pattern. Use a scale factor of 0.5, 2, and 3 to draw each size.

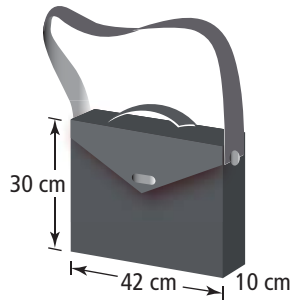


Extend

14. Draw an enlargement of the quadrilateral on grid paper using a scale factor of 2.

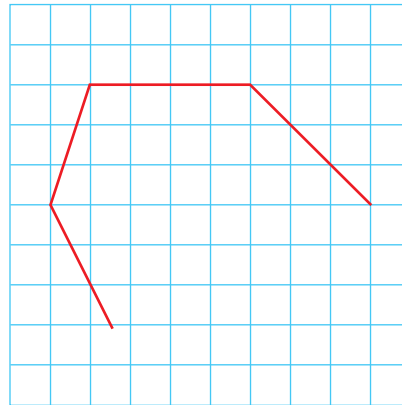


- 15.** Keita made a new bag for her laptop. Her cousin would like the pattern so she can make one. Draw a pattern using the actual measurements. You do not have to include the flap or the strap. Then, reduce the pattern so it will fit on a piece of notebook paper.

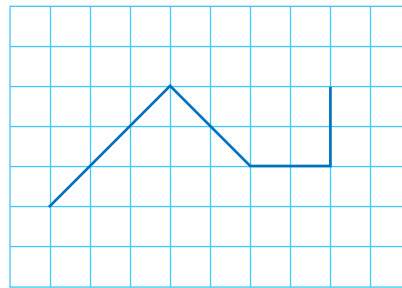


- 16.** Create a scale diagram of your classroom.
- Measure the dimensions of the classroom and items that can be seen in a top view, including desks, tables, cupboards, and shelves.
 - Choose a scale factor and draw the scale diagram on grid paper.
 - What changes would you make to the layout of your classroom? Where would you place desks or tables? Draw a scale diagram of your new classroom layout.

- 17.** Draw an image so that each line segment is
- 40% of the original length



- 2.5 times the original length



Math Link

Use what you have learned to design a project that requires a scale diagram. You may wish to choose one of the following projects:

- Design at least four different hopscotch patterns for a local recreational area.
- Design or enlarge a pattern for an outfit to wear at your school's fashion show. Assume that you have the instructions and the skills needed to construct the outfit.
- Design a modification of a car's blueprints for a project in your automotive course.
- Design a miniature version of a landmark in your province for display in a tourism project.
- Design a web page featuring a topic and related visuals of your choice. For example, you might feature contemporary drum designs.

- What design project will you choose?
- Research your project using the library or the Internet. Obtain or develop an initial design or drawing.
- Using grid paper, draw an enlargement or a reduction of your design to scale.



Haida hand drum design