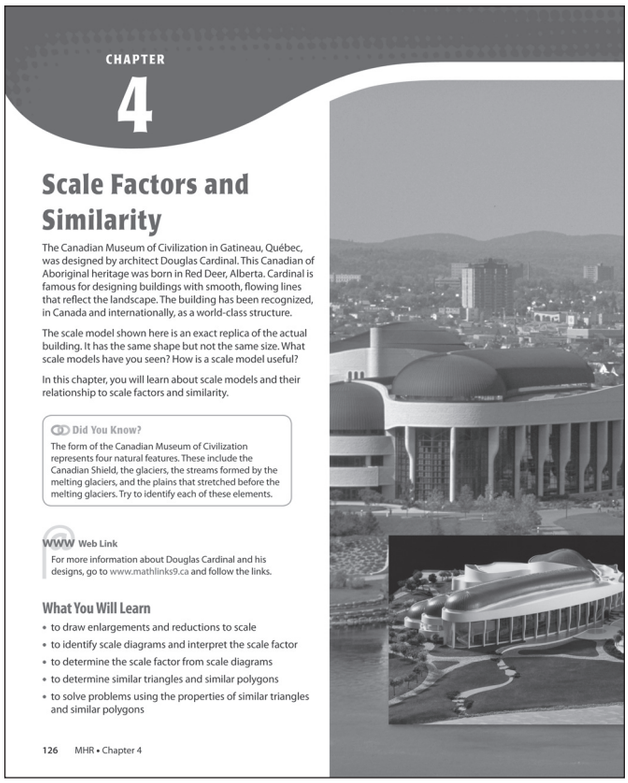
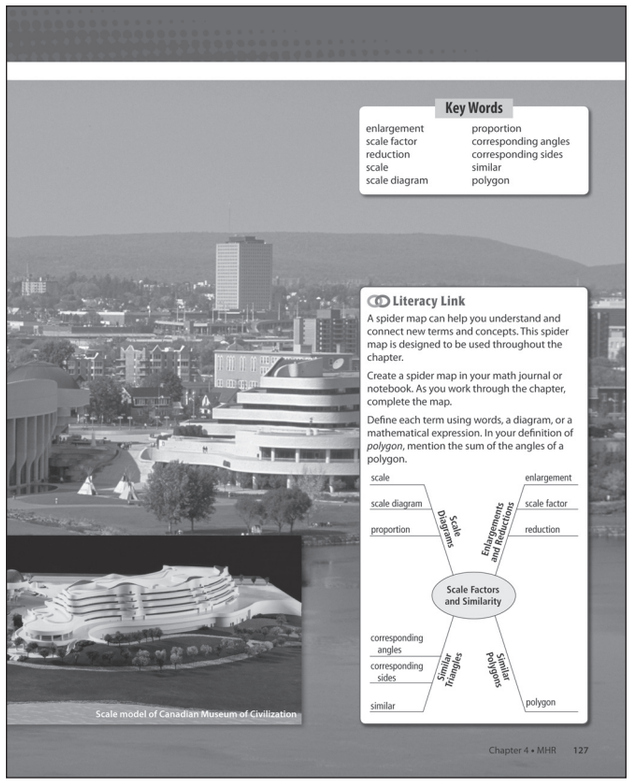




***MathLinks 9*, pages 126–129**

Suggested Timing
40–50 minutes

Materials
- sheet of 11 × 17 paper
- two sheets of 8.5 × 11 paper
- two sheets of 8.5 × 11 grid paper
- ruler
- scissors
- stapler

Blackline Masters
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
Master 17 Spider Map
BLM 4–1 Chapter 4 Math Link Introduction
BLM 4–2 Chapter 4 Get Ready
BLM 4–4 Chapter 4 Problems of the Week

Key Words
enlargement, scale factor, reduction, scale, scale diagram, proportion, corresponding angles, corresponding sides, similar, polygon

What's the Math?

In this chapter, students extend their prior knowledge of ratios and proportions to investigate scale diagrams, scale factors, and similarity of triangles and polygons. Students begin by identifying enlargements and reductions, and interpreting the scale factor before drawing enlargements and reductions to scale using different methods. Next, they determine the scale factor for scale diagrams using different methods that include proportions. Then, students apply what they have learned to determine properties of similar triangles and similar polygons, and solve problems using the properties of similarity.

Planning Notes

As a class, have students compare the pictures of the actual museum and the scale model. Use prompts such as the following:
- What is a scale model? (a representation of an object that is smaller or larger than the actual object)
- How are the two images of museums similar? (same shape)
- How are they different? (different sizes)

During the discussion, record any terms related to scale and similarity on the board and have students refer to the list when they create their spider map.

Invite students to discuss scale models that they have seen or own. They might mention models of cars, trucks, heavy equipment, trains, railways, doll houses, rockets and spaceships, ships, tanks, or robots. You might ask:
- What do you notice about the scale model? (The scale model is smaller than the original.)

- What is the purpose of the scale model? (It was used as a guide to make the full-size object.)

You might discuss what scale models are used for. For example, architects use scale models to assess designs before building, and to help sell constructions. Sales people use them to sell new products such as vehicles and heavy equipment. Engineers test scale models to find out how they perform before spending money on building the full-size model.

Literacy Link Spider maps are graphic organizers that help students understand and make connections between concepts. This map provides a way for students to summarize each section of the chapter by defining terms that relate to scale factors and similarity.

At the beginning of the chapter, have students create a spider map in their notebook or journal. You may wish to model how to develop the spider map using an overhead copy of **Master 17 Spider Map**.

Have students keep the spider map at the beginning of their notebook or journal so it can be easily accessed. Students will need to use a whole page for their spider map. Have them put the central oval in the centre of the page so that the spider map can be expanded. Caution students to use small printing and to try to be as neat as possible.

Students will complete the spider map as they work on Chapter 4.

- By the end of section 4.1, have students complete definitions for *enlargement*, *scale factor*, and *reduction* using words, diagrams, and mathematical expressions, and include an example for each term.
- By the end of section 4.2, have students complete definitions for *scale*, *scale diagram* and *proportion* using words, diagrams, and mathematical expressions, and include an example for each term.
- By the end of section 4.3, have students complete definitions for *corresponding angles*, *corresponding sides*, and *similar* using words, diagrams, and mathematical expressions, and include an example of similar triangles.
- By the end of section 4.4, have students complete a definition for *polygon* using words, diagrams, and mathematical expressions. Have them address the sum of the angles in a polygon.

Meeting Student Needs

- Consider having students complete the questions on **BLM 4–2 Chapter 4 Get Ready** to activate the prerequisite skills for this chapter.
- Students may benefit from reactivating their knowledge and skills with ratios and proportions.
- Consider pre-teaching the vocabulary related to scale factors and similarity.
- Encourage students to identify the features in the form of the Canadian Museum of Civilization as described in the Did You Know? on page 126.
- You might discuss scale models of innovative building designs where students live. For example, you might mention the Igloo church in Inuvik or the Nunavut legislative building in Iqaluit. You may find the related Web Link on this TR page useful.
- Some students may benefit from using **Master 17 Spider Map**, which provides scaffolding for the Literacy Link activity.
- Some students may find it helpful to add the page reference in the student resource for the definition of each term on the spider map.

ELL

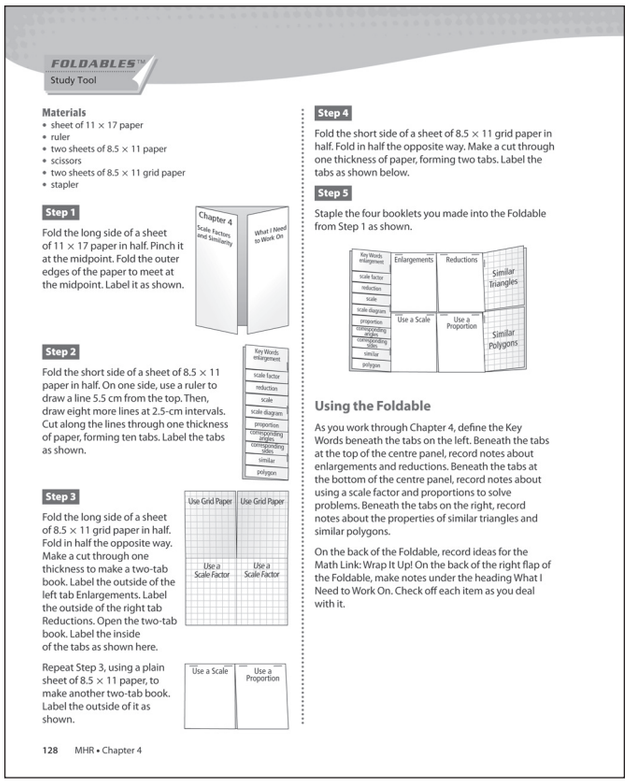
- Teach the following terms in context: *replica*, *monuments*, *Canadian Shield*, and *glaciers*.
- Consider displaying the Key Words on a math word wall. Encourage students to create their own vocabulary dictionary and illustrate terms using visuals. Matching a visual with a Key Word helps reinforce students' understanding of vocabulary.

Gifted and Enrichment

- Challenge students to research Douglas Cardinal and his designs, and present a report using visuals to showcase his work. They may find the related Web Link in the student resource on page 126 helpful. Alternatively, they might research the use of scale and proportion in the works of the Group of Seven or Aboriginal artists Bill Reid and Roy Henry Vickers.

Web Link

For information about Iqaluit architect Keith Irving and his design for the Nunavut legislative building, go to www.mathlinks9.ca and follow the links.



FOLDABLES™
Study Tool

Materials
- sheet of 11 × 17 paper
- ruler
- two sheets of 8.5 × 11 paper
- scissors
- two sheets of 8.5 × 11 grid paper
- stapler

Step 1

Fold the long side of a sheet of 11 × 17 paper in half. Pinch it at the midpoint. Fold the outer edges of the paper to meet at the midpoint. Label it as shown.

Chapter 4
Scale Factors and Similarity
What I Need to Work On

Step 2

Fold the short side of a sheet of 8.5 × 11 paper in half. On one side, use a ruler to draw a line 5.5 cm from the top. Then, draw eight more lines at 2.5-cm intervals. Cut along the lines through one thickness of paper, forming ten tabs. Label the tabs as shown.

Key Words: enlargement
scale factor
reduction
scale
scale diagram
proportion
corresponding angles
corresponding sides
similar
polygon

Step 3

Fold the long side of a sheet of 8.5 × 11 grid paper in half. Fold in half the opposite way. Make a cut through one thickness to make a two-tab book. Label the outside of the left tab Enlargements. Label the outside of the right tab Reductions. Open the two-tab book. Label the inside of the tabs as shown here.

Use Grid Paper | Use Grid Paper
Use a Scale Factor | Use a Scale Factor

Repeat Step 3, using a plain sheet of 8.5 × 11 paper, to make another two-tab book. Label the outside of it as shown.

Use a Scale | Use a Proportion

Step 4

Fold the short side of a sheet of 8.5 × 11 grid paper in half. Fold in half the opposite way. Make a cut through one thickness of paper, forming two tabs. Label the tabs as shown below.

Step 5

Staple the four booklets you made into the Foldable from Step 1 as shown.

Key Words: enlargement | Enlargements | Reductions
scale factor
reduction
scale
scale diagram
proportion
corresponding angles
corresponding sides
similar
polygon
Use a Scale | Use a Proportion
Similar Triangles
Similar Polygons

Using the Foldable

As you work through Chapter 4, define the Key Words beneath the tabs on the left. Beneath the tabs at the top of the centre panel, record notes about enlargements and reductions. Beneath the tabs at the bottom of the centre panel, record notes about using a scale factor and proportions to solve problems. Beneath the tabs on the right, record notes about the properties of similar triangles and similar polygons.

On the back of the Foldable, record ideas for the Math Link: Wrap It Up! On the back of the right flap of the Foldable, make notes under the heading What I Need to Work On. Check off each item as you deal with it.

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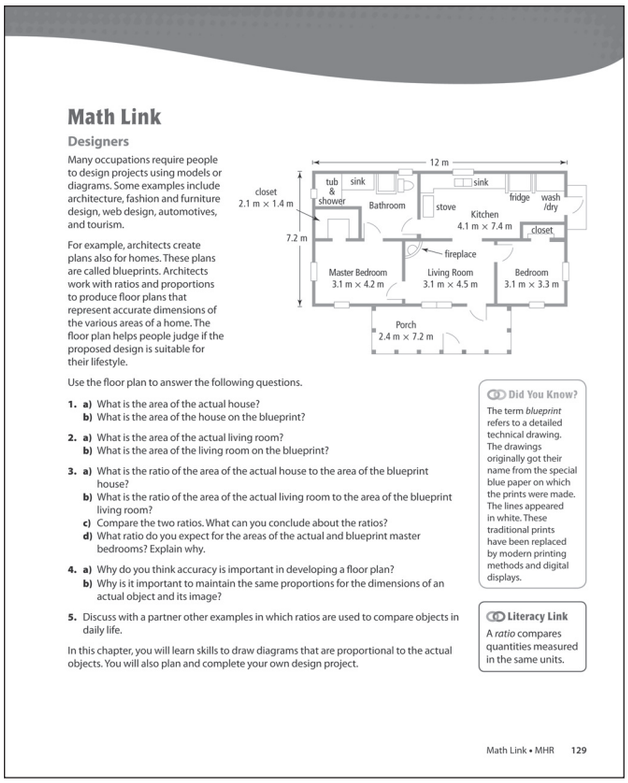

Math Link

Designers

Many occupations require people to design projects using models or diagrams. Some examples include architecture, fashion and furniture design, web design, automotives, and tourism.

For example, architects create plans also for homes. These plans are called blueprints. Architects work with ratios and proportions to produce floor plans that represent accurate dimensions of the various areas of a home. The floor plan helps people judge if the proposed design is suitable for their lifestyle.

12 m
closet 2.1 m × 1.4 m
tub & shower
sink
Bathroom
sink
stove
fridge
wash /dry
Kitchen 4.1 m × 7.4 m
closet
7.2 m
fireplace
Master Bedroom 3.1 m × 4.2 m
Living Room 3.1 m × 4.5 m
Bedroom 3.1 m × 3.3 m
Porch 2.4 m × 7.2 m

Use the floor plan to answer the following questions.

1. **a)** What is the area of the actual house?
   b) What is the area of the house on the blueprint?
2. **a)** What is the area of the actual living room?
   b) What is the area of the living room on the blueprint?
3. **a)** What is the ratio of the area of the actual house to the area of the blueprint house?
   b) What is the ratio of the area of the actual living room to the area of the blueprint living room?
   c) Compare the two ratios. What can you conclude about the ratios?
   d) What ratio do you expect for the areas of the actual and blueprint master bedrooms? Explain why.
4. **a)** Why do you think accuracy is important in developing a floor plan?
   b) Why is it important to maintain the same proportions for the dimensions of an actual object and its image?
5. Discuss with a partner other examples in which ratios are used to compare objects in daily life.

In this chapter, you will learn skills to draw diagrams that are proportional to the actual objects. You will also plan and complete your own design project.

Did You Know?
The term *blueprint* refers to a detailed technical drawing. The drawings originally got their name from the special blue paper on which the prints were made. The lines appeared in white. These traditional prints have been replaced by modern printing methods and digital displays.

Literacy Link
A *ratio* compares quantities measured in the same units.

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Foldables Study Tool

Have students make the Foldable in the student resource to keep track of the information in the chapter. Have students record definitions for Key Words on the inside flap on the left.

As students work on section 4.1, have them use the top of the centre panel to record notes about enlargements and reductions, and, an example of using grid paper and a scale factor to enlarge and reduce an image to scale. As students work on section 4.2, have them use the bottom of the centre panel to record notes, and an example of using a scale and a proportion to solve a problem involving scale. As they work on sections 4.3 and 4.4, have students use the inside flap on the right to record notes and an example problem using similar triangles and similar polygons.

Filling in the What I Need to Work On section as they progress through the chapter will assist them in identifying and solving difficulties with concepts, skills, and processes.

Students can use the back of the Foldable to record ideas for the Wrap It Up! Note that there is no room on the Foldable for the Math Links throughout the chapter. You may wish to have students keep track of this work in their math portfolio or slip it into a plastic envelope.

Have students store the Foldable in a binder by punching holes along one of the long sides. Alternatively, you may wish to provide students with a plastic envelope that fits into their binder.

Math Link

Throughout the Math Links in this chapter, students will work on a design project that involves scale diagrams and similarity.

As a class, read the introduction. If you have not done so earlier, you might have students discuss occupations that rely on using models or diagrams. Direct students to the Did You Know? that explains a blueprint. You might show students an example of a blueprint or a floor plan and point out some features.

Literacy Link Direct students to the Literacy Link that reviews the term *ratio*. Have students recall what they know about ratios (e.g., two-term ratios, three-term ratios, part-to-part ratios, part-to-whole ratios), ratio notation ($a:b$ or a to b), and how they can be expressed as fractions, decimals, and percents. Consider using examples from the classroom (e.g., boys compared to girls, boys compared to girls and boys), or have students make suggestions.

Have students use the given floor plan and work in pairs or small groups to complete #1 to 5 before discussing their responses as a class. Note that students will need to calculate areas in the same units for #1 and 2. Coach them to express the actual lengths in centimetres and calculate the area in square centimetres. Then, they can compare ratios since all areas will be expressed in square centimetres. For #1 and 2, have students express answers to the nearest tenth. For #3, have students express the answer to the nearest thousand. Some students may perform the calculations for #3 using dimensions in metres rather than centimetres. Note that converting between units of area, such as from square centimetres to square metres, goes beyond the grade 9 curriculum.

It may be helpful for students to draw diagrams to assist them with their work. You may wish to provide copies of **Master 8 Centimetre Grid Paper** and **Master 9 0.5 Centimetre Grid Paper**.

It is important for students to complete the Math Links in this chapter as they help them work on the elements of the design project that will be finalized in the Wrap It Up! You might use this opportunity to direct students to the Wrap It Up! on page 163 in the student resource and have them read about the requirements for the project. This will give them a sense of where the Math Link is heading. The Wrap It Up! is a summative assessment.

Meeting Student Needs

- Consider creating the Foldable ahead of time to use as a model.
- Some students may benefit from recalling what they know about area and how to find the area of a rectangle. You might ask students how they would calculate the area of the classroom.
- Consider allowing students to work on the Math Link in groups or as a class.
- For students with motor challenges, you might provide the measurements of the blueprint house and living room to eliminate potential errors in measuring with a ruler.
- To help them to get started, some students may benefit from using **BLM 4–1 Chapter 4 Math Link Introduction**, which provides scaffolding for this activity.
- Consider inviting an architect to speak to the class about how they create blueprints or floor plans. They may bring a variety of blueprints for students to see. Alternatively, bring in some blueprints for a home or a school for students to look at.

ELL

- Teach the following words in context: *occupations, architecture, automotives, blueprints, ratios, proportions,* and *dimensions*.

Common Errors

- Some students may not know the difference between *actual* and *blueprint*.

R_x Explain that the blueprint is a reduced image of the real building.

Answers

Math Link

1. Example: **a)** 1 036 800 cm^2 **b)** 43.9 cm^2

2. Example: **a)** 139 500 cm^2 **b)** 5.8 cm^2

3. Example: **a)** $\frac{1\,036\,800\ cm^2}{43.9\ cm^2} = 23\,617.31\ cm^2 = 24\,000\ cm^2$

b) $\frac{139\,500\ cm^2}{5.8\ cm^2} = 24\,051.7\ cm^2 = 24\,000\ cm^2$

Note: Some students may perform the calculations using dimensions in metres and obtain an answer of approximately 2.4 m^2.

c) The ratios are approximately the same.

d) The ratio for the area of the actual master bedroom and the drawing of the master bedroom should be the same as the other ratios. The diagram of the master bedroom was drawn to the same scale as the rest of the house.

4. a) Example: Accuracy is important for developing a floor plan so the proportions (e.g., area, length of walls) of each room remain the same in the drawing as in the actual house.

b) Example: Maintaining correct proportions is important to make conversion to actual measurements from the drawing easier.

5. Example:

- Artists use ratios to determine how large to make each facial feature in relation to the other features and how to align the features on the head for a portrait.
- Skiers use ratios to determine the correct length of skis for their height.