# 6.4 Scale Models

**Student Text Pages**
327–334

**Suggested Timing**
80 min

**Tools**
- scissors
- protractors
- rulers
- tape
- square dot paper
- computers
- *The Geometer's Sketchpad®*
- isometric dot paper

**Related Resources**
BLM 6-12 Section 6.4 Scale Models
BLM 6-13 Section 6.4 Use the Transform Menu in The Geometer's Sketchpad®
BLM G-4 Square Dot Paper
BLM G-5 Isometric Dot Paper
BLM T-2 *The Geometer's Sketchpad®* 3
BLM T-3 *The Geometer's Sketchpad®* 4
BLM A-8 Application General Scoring Rubric

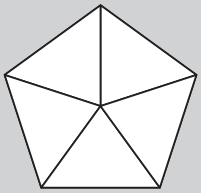
## Link to Prerequisite Skills

Students should complete Prerequisite Skills questions 4 to 9 before proceeding with this section.

### Warm-Up

**1.** A juice can has a height of 12 cm, and must hold at least 350 mL of juice. Find the minimum radius required, to the nearest centimetre.

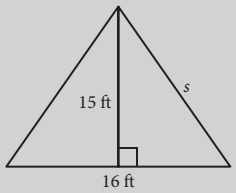
**2.** Pilar used a ruler and a compass to draw a regular pentagon using five congruent isosceles triangles, as shown.



**a)** What is the measure of each of the five angles at the centre of the pentagon?

**b)** What is the measure of the other two angles inside each triangle?

**3.** At the base, the width of an A-frame cabin is 16 ft, and its height is 15 ft. Find the slant height of the roof.




**Warm-Up Answers**

**1.** 3 cm

**2. a)** 72° **b)** both 54°

**3.** 17 ft

## Teaching Suggestions

### Warm-Up

- Write the Warm-Up questions on the board or on an overhead. Have students complete the questions independently. Then, discuss the solutions as a class.

### Section Opener

- Ask students to suggest instances in which scale models are an integral part of the planning for a project or product. Examples may include a recreation centre, a new vehicle, a passenger aircraft (the model is also used for wind tunnel testing), a cell phone, or office furniture.

### Examples

- Have students work through the Examples as a class before proceeding to the Discuss the Concepts. Alternatively, have students complete the Examples independently or in small groups before reviewing them as a class.

- For Example 1, the solution shown in the text uses systematic trial to find the radius. A more rigorous approach would be to solve the volume equation for $r$, and then to calculate the relevant cube root.
- Students could use the tissue roll net from Section 6.2, Investigate 2 as a visual aid when sketching the net for the tank.
- For Example 2, Method 1, students should use a protractor to measure the angles. Use a compass to measure off lengths taken from a ruler. This is more accurate than using the ruler to draw lengths directly.
- An alternative approach is to make three templates: one for the triangles that are used to assemble the pentagon, one for the square, and one for the equilateral triangles that make up the roof. The templates can be used to trace all of the required polygons. This method is faster than drawing each part individually, but may also introduce errors. This can lead to problems with edge-matching when folding the net. See the notes in the Common Errors section.
- Method 2 uses the **Transform** menu in *The Geometer's Sketchpad*®. If this is the first time that you or your students have used the Transform menu, consider first completing **BLM 6-13 Section 6.4 Use the Transform Menu in *The Geometer's Sketchpad*®**. This activity introduces the basic transformations: translation and rotation.
- The construction presented in Example 3 requires sides of different lengths. If using drinking straws or coffee stir sticks, have students check the measurements after each cut to ensure that their lengths are correct.

## Key Concepts

- Sometimes scale models are the main intent behind an activity. Hobbyists build and operate scale models of aircraft, automobiles, trains, and other vehicles. Historians make scale models of historic battle sites, and populate them with scale model armies to gain a better understanding of the events that occurred and the reasons for them. Filmmakers build accurate scale models of sets that would be too expensive to reproduce in full size, and use computer graphic imagery (CGI) to place actors in the frame.

## Discuss the Concepts

- Have the students work with a partner. Discuss the answers as a class.

**Discuss the Concepts Suggested Answers (page 331)**

**D1.** No. Any object with surfaces that curve in more than one direction simultaneously, such as a sphere, cannot be constructed using a net. If the object is cut apart, the pieces will not lie flat like a net.

**D2.** Answers may vary. Sample answer: Orthographic drawings can present views from different perspectives, such as how far a new roof will overhang a neighbouring property. An isometric perspective drawing cannot accurately represent a complex building, with gables or turrets. A scale model might provide more detail than orthographic drawings but a model might be impractical to store.

## Practise (A)

- Encourage students to refer to the Examples before asking for assistance.
- Have copies of **BLM G-4 Square Dot Paper** and **BLM G-5 Isometric Dot Paper** available.
- For more information about the Avro Arrow in **question 2**, go to the McGraw-Hill Ryerson Web-site at *www.mcgrawhill.ca/books/foundations11* and follow the links.

**Common Errors**

- Some students will have difficulty forming curved surfaces, such as the walls of a cylinder. Paper can have a tendency to crease or fold in undesired places.

$R_x$ Have cylindrical cans or rolls of various diameters available that students can use to form their curved surfaces before attempting to tape them in place.

- Some students may be careless when cutting drinking straws, so that the pieces are not of equal length.

$R_x$ Before assembling their scale models, have students line up all the parts on a flat surface and check their measurements. Pieces that are inaccurate should be re-cut.

- Some students will accumulate enough errors in a complicated net that the edges will not fit together evenly, leaving gaps.

$R_x$ Provide wide masking tape to cover the gaps.

**Accommodations**

**Language**—have a reading partner assist with problems

**Motor**—use large dot paper or grid paper and encourage students to use a large scale for diagrams

## Apply (B)

- **Question 6** is a Literacy Connect. You may wish to assign this question as a journal entry or to discuss the question as a class.
- **Question 10** is an extension of Example 2. You can scaffold the question by asking students to determine the angles required in the six triangles used to build the hexagon.
- **Question 12** links to the Chapter Problem. Remind students to keep the solution to this question handy as the methods they used may help them with the Chapter Problem Wrap-Up.

## Extend (C)

- Assign the Extend questions to students who are not being challenged by the questions in Apply.
- **Questions 14** and **15** have students use a systematic trial to produce a net for a cone. It can also be produced using calculations similar to those in section 6.2, Apply (A), question 7. Systematic trial is a suitable method for students in this course.

## Mathematical Process Expectations

| Process Expectation | Questions |
|---|---|
| Problem Solving | 3, 4, 6, 9, 12, 13 |
| Reasoning and Proving | 11 |
| Reflecting | 3, 4, 6, 11 |
| Selecting Tools and Computational Strategies | 1, 2, 8–10, 12 |
| Connecting | 2, 3 |
| Representing | 5–10, 13, 14 |
| Communicating | 3, 4, 6 |

## Ongoing Assessment

- You may wish to use **BLM A-8 Application General Scoring Rubric** to assess students' responses to **question 9**.

## Extra Practice

- You may wish to use **BLM 6-12 Section 6.4 Scale Models** for remediation or extra practice.