6.1 Investigate Geometric Shapes and Figures

Student Text Pages
296–305

Suggested Timing
80 min

Tools
- copy of Leonardo da Vinci's painting *Mona Lisa*
- rulers
- computers
- *The Geometer's Sketchpad®*
- centimetre grid paper
- coloured pencils or markers
- pattern blocks, pentominoes, or tangrams
- pattern block applet
- grid paper
- size A4 paper

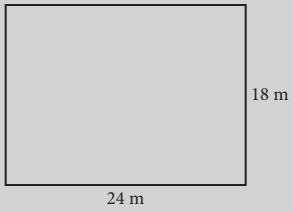
Related Resources
BLM 6-3 Section 6.1 Investigate Geometric Shapes and Figures
BLM 6-4 Section 6.1 Pattern Block Template
BLM 6-5 Section 6.1 Achievement Check Rubric
BLM G-1 Grid Paper
BLM G-6 Centimetre Grid Paper
BLM T-2 *The Geometer's Sketchpad® 3*
BLM T-3 *The Geometer's Sketchpad® 4*
BLM A-18 Opinion Piece Checklist

Link to Prerequisite Skills

Students should complete Prerequisite Skills questions 1 to 3 before proceeding with this section.

Warm-Up

1. Find the ratio of the length to the width for this rectangle.



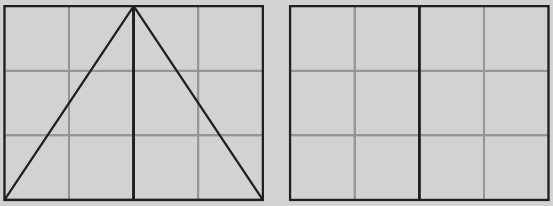
2. Show how you can cover the area on a 3-by-4 grid, without gaps or overlaps, using each shape
a) congruent triangles.
b) congruent rectangles

3. The legs of a right triangle are 33 cm and 56 cm. Find the length of the hypotenuse.

Warm-Up Answers

1. 3:4

2. Answers may vary. Sample answers:



3. 65 cm

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

- You may wish to introduce the concept of tessellations using students' clothing. You might want to bring in pieces of clothing with regular tessellations and semi-regular tessellations. You might be able to find a fun-loving student who will agree to wear an outrageously-tessellated item of clothing as a "plant".

Investigate

- In Investigate 1, a photograph of the *Mona Lisa* is reproduced in the student text. If you use Method 1 (pencil and paper), you can use a photocopier to enlarge the photograph. Alternatively, you can find a copy of the painting on the Internet and print it. In Method 2, students paste the image into *The Geometer's Sketchpad*®. They should select an image that is suitable for the screen resolution in use. For example, if the computers in your laboratory operate at a screen resolution of 1024 by 768, select an image with a vertical resolution of about 600. The resolution of each image is usually shown below the image.
- For Method 2, supply students with copies of **BLM T-2 *The Geometer's Sketchpad*® 3** or **BLM T-3 *The Geometer's Sketchpad*® 4**. Students should keep these BLMs and refer to them throughout the chapter as needed.
- As an extension, have students repeat Investigate 1 using a digital photograph of themselves.
- For Investigate 2, distribute copies of **BLM G-6 Centimetre Grid Paper**.
- Have students use manipulatives such as pattern blocks, pentominoes, or tangrams to create tessellations. If you do not have access to these manipulatives, download templates from the Internet and cut the shapes from coloured construction paper or Bristol board or use **BLM 6-4 Section 6.1 Pattern Block Template**.
- Students can experiment with tessellations using online interactive applets at a number of Web-sites. Go to the McGraw-Hill Ryerson Web-site at *www.mcgrawhill.ca/books/foundations11* and follow the links. Or use a search engine, and the keywords "tessellation" and "applet" to find other applets.
- For Investigate 3, distribute copies of **BLM G-1 Grid Paper**.
- Ask students to look for cell phone towers and note their locations. Use coloured pins to plot the locations on a map. Use the scale on the map to determine the spacing between towers.
- If the file **polygons.gsp** is in your Tool Folder, you can easily draw a regular hexagon. Click and hold **Custom Tools**, and select **Polygons**. You can also download **Custom Tools** and obtain other resources for *The Geometer's Sketchpad*®. Go to the McGraw-Hill Ryerson Web-site at *www.mcgrawhill.ca/books/foundations11* and follow the links

Technology

- You may wish to use the Use Technology section on pages 344–345 at this point. The section gives instructions on how to use *The Geometer's Sketchpad*® to create tessellations using rotations. Supply students with **BLM 6-13 Section 6.4 Use the Transform Menu** in *The Geometer's Sketchpad*® if they are not familiar with using the Transform menu.

Investigate Answers (pages 296-300)

Investigate 1

1. Answers may vary. Sample answer: $l = 10.9$ cm, $w = 6.8$ cm; $\frac{l}{w} \doteq 1.6$

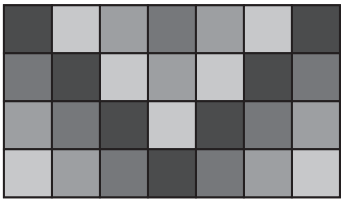
3. Answers may vary.

Investigate 2

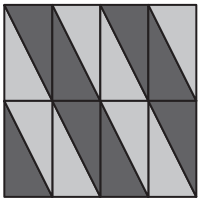
Method 1: Use Pencil and Paper

Drawings may vary.

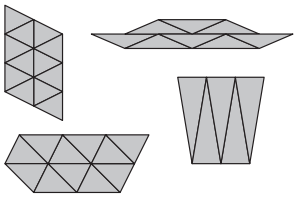
1.



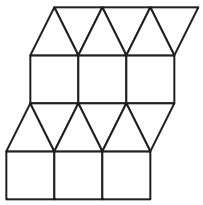
2.



3. Yes. Any triangle can be used to tile the plane.



4.



5. 360°

Method 2

3. – 6. Sketches may vary. See examples in Method 1.

5. Yes. Any triangle can be used to tile the plane.

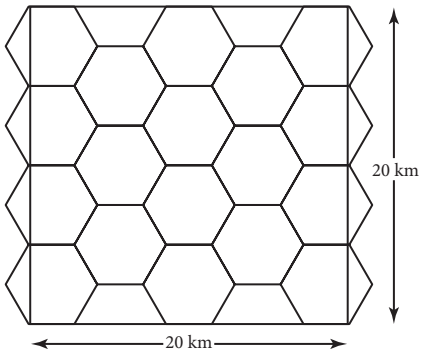
7. 360°.

Investigate 3

Method 1

1. – 3. Answers may vary. Sample answers:

1., 2.



3. 22 towers

4. In each case, the geometric shape or shapes chosen must tile the plane with no gaps or overlaps.

Method 2

1. –3. Drawings may vary. See drawing from Method 1.

4. Answers may vary depending on drawing.

5. In each case, the geometric shape or shapes chosen must tile the plane with no

Example

- Have students work through the Example as a class before proceeding to the Discuss the Concepts. Alternatively, have students complete the Example independently or in small groups before reviewing them as a class.
- As an extension to the solution, you can download pictures of the Great Pyramid from the Internet and paste them into *The Geometer's Sketchpad*®. Students can measure the photograph to find the ratio.

Key Concepts

- Ask students to identify rectangles in the classroom or around the school that appear to be golden rectangles. Have students measure and calculate the ratio of length to width to check.
- Ask student to suggest places they have seen tessellations other than those already discussed. Examples include brick driveways or tiled bathroom floors.

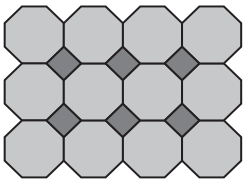
Discuss the Concepts

- Have students work with a partner. Discuss the answers as a class.
- Consider taking students on a "math walk" to look for geometric shapes, either within the school, or in the neighbourhood around the school, as appropriate for your location. Alternatively, students can be asked to look for geometric shapes on the way to and from school, or around the area in which they live.
- For **question D2**, the shape shown can be drawn using *The Geometer's Sketchpad*®. Then, it can be copied and pasted to form the tessellation.

Discuss the Concepts Suggested Answers (page 301)

D1. Answers may vary.

D2. Yes.



Practise (A)

- Encourage students to refer to the Investigates and the Example before asking for assistance.
- For **question 1**, you may wish to have students investigate the properties of regular polygons that will tessellate. They should discover that the measure of an interior angle must be a factor of 360°.

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. Literacy Connect questions offer the opportunity to explore literacy issues in the mathematics classroom and within the context of mathematics.
- For **question 8**, remind students that pictures are easily found using the **Images** option on a search engine.
- You may wish to extend **question 9** by asking students to suggest other actors or popular personalities that they think of as "round-faced" or "long-faced." Have students print photographs of these people and measure to check.
- For **question 10**, not all breeds of cats have the same face ratios as the tabby. You can extend this question, and make it more personal, by asking students to check the face ratios of cats they know, especially specific breeds such as Siamese or Himalayan.
- **Question 11** links to the Chapter Problem. If time permits it can be fun to make a 12-knot rope, and use it to lay out a right angle. Remind students to keep the solution to this question handy as the methods they used may help them with the Chapter Problem Wrap-Up.
- If you have students in your class who play and read music, you may wish to extend **question 12** by challenging these students to find other examples of congruent triangles in written music. Some may involve reflections, either horizontally or vertically.

Common Errors

- Some students may change a picture's aspect ratio when resizing an image, resulting in calculation errors.

R_x Have students check the screen resolution on their computers before selecting a picture to cut and paste. Right-click anywhere on the desktop, and select **Properties**. Click on the **Settings** tab and inspect the screen resolution. Be sure to select an image that is about $\frac{2}{3}$ to $\frac{3}{4}$ of the screen resolution for best results.

- Some students may tile the plane with non-tessellating polygons by altering the shapes of the polygons.

R_x After students create a tessellation, have them swap their drawing with a partner to check that it is a true tessellation.

Accommodations

Memory—encourage students to use index cards or a formula sheet

Spatial—provide diagrams to support the instructions for tessellations

- **Question 14** is an Achievement Check question. It can be used as a diagnostic or formative assessment, or assigned as a small summative assessment piece. You may wish to use **BLM 6-6 Section 6.1 Achievement Check Rubric** to assist you in assessing your students. Any hexagon with opposite sides equal can tile a plane because the angles around the vertex will add to 360°. Check students' drawings if they say their hexagon cannot tessellate. Their hexagons might be different sizes or they might be rotating the hexagons so the sides do not match up.

Extend (C)

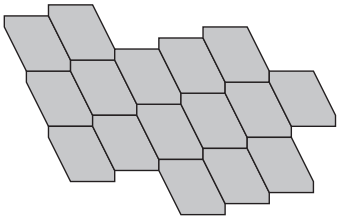
- Assign the Extend questions to students who are not being challenged by the questions in Apply.
- For **question 16**, A4 paper is available at office supply stores.
- For **question 17**, students can use an applet that allows odd shapes to be used to form tessellations on *The Geometer's Sketchpad*®. Go to the McGraw-Hill Ryerson Web-site at *www.mcgrawhill.ca/books/foundations11* and follow the links

Achievement Check Answers (page 305)

Drawings may vary.

14. a)

b)



Literacy Connect

- Distribute copies of **BLM 6-5 Section 6.1 Literacy Connect**. Have students work in pairs to complete this read and understand opinion piece. You may wish to use **BLM A-18 Opinion Piece Checklist** to assess students' responses.
- Go to the McGraw-Hill Ryerson Web-site at *www.mcgrawhill.ca/books/foundations11* and follow the links for more information on passive design.

Mathematical Process Expectations

Process Expectation	Questions
Problem Solving	14
Reasoning and Proving	1, 7–11, 15, 16
Reflecting	7, 11
Selecting Tools and Computational Strategies	2, 7, 9, 10, 12, 15, 16
Connecting	3–5, 7–11
Representing	14, 13, 15–17
Communicating	3–6, 11–15

Extra Practice

- Use **BLM 6-3 Section 6.1 Investigate Geometric Shapes and Figures** for remediation or extra practice.