Chapter 1 Lesson Plans

MathLinks 9 Pre-Planning for Chapter 1

STRAND/ORGANIZER: Shape and Space (3-D Objects and 2-D Shapes) (Transformations)

General Outcomes: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Describe and analyze position and motion of objects and shapes.

1. Before getting started with lesson planning for Chapter 1 Symmetry and Surface Area, you need to understand what skills students have already been exposed to.

- If students in your jurisdiction have *not* completed the new Grade 8 WNCP (2006) curriculum, they should have some understanding of the following outcomes from the previous curriculum:
  Grade 7 (1995):
  ☑ Create, analyze and describe designs, using translations (slides), rotations (turns) and reflections (flips).
  ☑ Relate reflections to lines and planes of symmetry.
  Grade 8 (1995):
  ☑ Estimate, measure and calculate the surface area and volume of any right prism or cylinder.
  ☑ Estimate and calculate the area of composite figures.

- If students in your jurisdiction *have* completed the new Grade 8 WNCP (2006) curriculum, they should have some understanding of the following:
  Grade 7 (2006):
  ☑ Perform and describe transformations (translations, rotations or reflections) of a 2-D shape in all four quadrants of a Cartesian plane (limited to integral number vertices).
  Grade 8 (2006):
  ☑ Determine the surface area of:
  - right rectangular prisms
  - right triangular prisms
  - right cylinders

  to solve problems.

2. To familiarize yourself with the features of *MathLinks 9*, you may wish to do the following:
- Review **A Tour of Your Textbook** (pp. ix–xiv) and **Problem Solving** (pp. xv–xix) to familiarize yourself with the features of the student resource.
- Review **Answers** (pp. 453–493), **Glossary** (pp. 494–500), and **Index** (pp. 501–504) to familiarize yourself with their contents.

3. Note that not every section within each chapter is meant to be a stand-alone lesson. In order to allow students time to experience the depth and breadth of a concept, some sections may take two or three classes to complete. The Teacher's Resource suggests time lines.

4. Before starting Chapter 1, read through the **chapter opener** (p. 2), **Key Words** (p. 3), **Math Links** (pp. 5, 15, 25, and 35), and **Math Link: Wrap It Up!** (p. 39). These sections will provide a sense of how the chapter concepts are tied together and how students will be asked to apply their learning.

5. The chapter begins with a **Literacy Link** showing a graphic organizer (p. 3) and a **Foldable** feature (p. 4).

a) The thematic map will help students organize their learning and activate previously learned concepts. **Master 15 Thematic Map** provides a reproducible copy.

b) Foldables provide unique ways for students to:
- organize their learning
- keep track of key words and examples
- organize their thinking
- keep track of what they need to work on in a particular chapter and use for review

Foldables are exciting ways for students to engage themselves in learning. Most take approximately 10 min to make.

A materials centre could make it easier for students to produce Foldables. This centre could range from a table at the back of the classroom to a box on a shelf. Stock the centre with paper, scissors, glue, tape, and markers. You may wish to help students stay organized and keep their Foldables for year-end reference by either:
- providing a file folder and storage box in the classroom, or
- using a page-protector pouch that students can keep in their binders. These can be purchased at a dollar store.

6. As part of your pre-planning for each chapter, review the related materials in:
- the Teacher's Resource for support in meeting the needs of all learners, a list of common errors, language learning skills, and rubric notes for the Math Link: Wrap It Up! questions,
- the Blackline Masters (BLMs) for additional questions, scaffolding of all Math Links, a chapter test, and assessment assistance,
- the *MathLinks 9 Practice and Homework Book* for additional exercises and scaffolding for concepts, and
- the Teacher Centre of the McGraw-Hill Ryerson Online Learning Centre for examples of student work for the Challenges and Tasks, scoring rubrics, additional challenges for students, and final exams.

MathLinks 9 Chapter 1, Lesson 1

Time: 40–50 min

STRAND/ORGANIZER: Shape and Space (3-D Objects and 2-D Shapes) (Transformations)

General Outcomes: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Describe and analyze position and motion of objects and shapes.

Specific Outcomes:

SS2 Determine the surface area of composite 3-D objects to solve problems.

SS5 Demonstrate an understanding of line and rotation symmetry.

Resources/Materials:

- BLM 1–1 *MathLinks 9* Scavenger Hunt

Lesson Objective:

Getting to Know the Student Resource

It is important for students to learn the different parts of the student resource. Choose from among the following approaches:

1. If you have the Teacher's Resource, you might use **BLM 1–1 *MathLinks 9* Scavenger Hunt**. Allow 20–30 min for this activity. Review the answers with students.
2. If you do not have the Teacher's Resource, use the introductory pages of the student resource: **A Tour of Your Textbook** (pp. ix–xiv) and **Problem Solving** (pp. xv–xix). Review these sections with students for about 20 min.
3. You might reference the introductory pages after the Scavenger Hunt to help students become familiar with them. Invite them to refer back to these pages at a later date. These are also excellent pages for parents to read, allowing them to gain an understanding of the instructional material.
4. Make sure students are aware of the location of the **Answers** (pp. 453–493), **Glossary** (pp. 494–500), and **Index** (pp. 501–504) and understand how to use them. Explain that the purpose of answers is to verify their calculations. Encourage students with an incorrect answer to revisit the related Example(s), identify where they may have gone wrong, and redo their calculations or revisit their thinking.

Starting Chapter 1:

Scan the teaching notes in the Teacher's Resource before starting any chapter. Then, review the notes for each lesson as you plan it. Note that timeframes can change depending on your particular mix of students.

If you do not have access to the Teacher's Resource, begin Chapter 1 by telling students that this chapter is about symmetry and surface area. They will begin by learning about line symmetry and rotation symmetry in the context of the real world and pure mathematical applications. Symmetry is compared with the geometry of transformations (translations, rotations, and reflections) studied in Grade 7. Students will then determine the surface area of composite solids using connections to symmetry.

MathLinks 9 Chapter 1, Lesson 2

Time: 40–50 min

STRAND/ORGANIZER: Shape and Space (3-D Objects and 2-D Shapes) (Transformations)

General Outcomes: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Describe and analyze position and motion of objects and shapes.

Specific Outcomes:

SS2 Determine the surface area of composite 3-D objects to solve problems.

SS5 Demonstrate an understanding of line and rotation symmetry.

Resources/Materials:

- *MathLinks 9*, pp. 2–5
- blank paper or Master 15 Thematic Map
- BLM 1–2 Chapter 1 Math Link Introduction
- BLM 1–3 Chapter 1 Get Ready or *MathLinks 9 Practice and Homework Book*, pp. 2–3
- BLM 1–5 Chapter 1 Problems of the Week
- sample chapter Foldable
- sheet of 11 × 17 paper
- three sheets of 8.5 × 11 paper
- sheet of grid paper
- scissors
- stapler

Teacher's Resource:

pp. 5–8

***MathLinks 9* Adapted Resource**

See corresponding chapter for adapted materials to support individual students.

Introduction:

Before working on Chapter 1, review the Get Ready and the Math Link (p. 5). Decide whether students will complete both of the activities or only one of them. The Get Ready assesses how well students know the prerequisite skills for this chapter. The Math Link also activates students' prior knowledge and skills related to Chapter 1 and, in addition, introduces the chapter problem.

You may wish to use additional materials and manipulatives, such as Mira™, peg boards and coloured elastics, grid paper, isometric dot paper, or symmetric shapes, including squares and butterflies to help assess students' prior knowledge and skills related to symmetry.

Read the chapter opener together (p. 2). Read through the What You Will Learn (p. 2) and the Key Words (p. 3). How many students can already define or describe the key words?

Ask students what *symmetry* means. Encourage them to find examples of symmetry in the classroom. Discuss how the butterfly demonstrates symmetry (e.g., shape, wing patterns, colour). You may wish to have students discuss how artists, architects, interior designers, and people with other careers that students mention use symmetry.

For ideas on introducing the chapter, view the ***MathLinks* 9 Lesson Planner Package and Program Overview Video**. In the main menu, select **Chapter Opener**.

Procedures/Activities/Instruction:

1. Have students complete the Get Ready. Use **BLM 1–3 Chapter 1 Get Ready** or *MathLinks 9 Practice and Homework Book,* (pp. 2–3).
2. Have students create a thematic map (p. 3) in their journal or notebook. You may wish to hand out **Master 15 Thematic Map** as a template. Suggest that students complete the part of the thematic map related to each section as they work through the chapter to help reinforce the key concepts.
3. Explain the purpose of a Foldable and show students the one you have made. Identify the materials they need to make their own. Make the Foldable together as a class or have students make their own following the instructions (p. 4). They could label it as shown or according to your directions. For more information about the Foldable, view the ***MathLinks* 9 Lesson Planner Package and Program Overview Video.** In the main menu, select **Foldable**.
4. Have students complete the Math Link. Read the introduction as a class. Ask them to comment on why the subtitle Reflections on Our World was included. Also, ask them to describe where they have seen symmetry. Have students examine the birch-bark biting done by Sally Milne for symmetry in the individual dragonflies as well as on opposite sides of the artwork.
   Refer students to the Literacy Link about transformations and translations to help them recall these terms.
   You may wish to have students complete the activity individually or in pairs. The questions help reactivate students' previous learning about translations and reflections.
   As a class, read and discuss the last paragraph, about designing artwork that demonstrates line and/or rotation symmetry for a playing card, a notepad, or an item that students choose.

Some students may benefit from using **BLM 1–2 Chapter 1 Math Link Introduction**, which provides scaffolding. Discuss and remediate any areas that students have difficulty with before beginning the next lesson.
Completing each of the Math Links in the chapter will assist students in doing the Math Link: Wrap It Up!
For additional teaching ideas for the Math Link, view the ***MathLinks* 9 Lesson Planner Package and Program Overview Video**. In the main menu, select **Math Link – Review**.

5. You may wish to have students start a collage that they can build on throughout the chapter to demonstrate symmetry and provide examples of line symmetry and rotation symmetry.

Problems of the Week:
BLM 1–5 Chapter 1 Problems of the Week provides additional problems to encourage ongoing problem solving and opportunities for students to use personal strategies in mathematics. These problems require students to think from different perspectives and experiment with a variety of approaches. Students can take the problems home and consult with parents, or work with a partner in class. Encourage students to complete at least one problem in each chapter.

Assessment:
1. Get Ready (Assessment *for* Learning)
2. Math Link (p. 5) (Assessment *for* Learning). You might use **BLM 1–2 Chapter 1 Math Link Introduction**.
3. Foldable (Assessment *for* Learning)

Math Link:
Have students use the centre pocket of their Foldable to store the real-world designs they collect and the designs they create for the Math Links. Consider reading through each Math Link (pp. 5, 15, 25, and 35) and the Math Link: Wrap It Up! (p. 39) as a class, so students have a good understanding of the chapter problem. Notes about the Math Links throughout the chapter will appear under Assessment.

Foldable Entry:
Encourage students to add the following terms from the Get Ready and Math Link to their Foldable. Have them use diagrams, illustrations, or explanations to define each term. Remind them to use their own words and examples.

transformation	translation	horizontal	vertical	oblique
reflection	line of reflection	rotation	centre of rotation	surface area
area of a rectangle	area of a triangle	area of a circle	symmetry	

MathLinks 9 Chapter 1, Lesson 3

Time: 40–50 min

STRAND/ORGANIZER: Shape and Space (Transformations)

General Outcome: Describe and analyze position and motion of objects and shapes.

Specific Outcome:
SS5 Demonstrate an understanding of line and rotation symmetry.

Achievement Indicators:
- ☑ Classify a given set of 2-D shapes or designs according to the number of lines of symmetry.
- ☑ Complete a 2-D shape or design given one half of the shape or design and a line of symmetry.
- ☑ Identify and describe the types of symmetry created in a given piece of artwork.

Resources/Materials:
- *MathLinks 9*, pp. 6–10
- BLM 1–4 Chapter 1 Warm-Up
- BLM 1–6 Section 1.1 Example 1
- scissors
- isometric dot paper or Master 7 Isometric Dot Paper
- tracing paper
- grid paper or Master 8 Centimetre Grid Paper
- ruler
- coloured pencils
- scissors
- glue or tape (optional)
- Foldable

Teacher's Resource:
pp. 9–15

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
For teaching ideas and other activities for section 1.1, go to the ***MathLinks* 9 Lesson Planner and Program Overview Video**. In the main menu, select Section 1.1 Line Symmetry. For ideas on teaching section 1.1 using technology,

in the main menu, select Linking Technology. Then, select Linking Technology to Section 1.1: Line Symmetry.

Review the key points about symmetry. You might discuss how the brain uses symmetry to scan for similarity in opposite sides of shapes and objects. See the Planning Notes in the Teacher's Resource (p. 9). You might use some examples of illusions to show how reflections and symmetry can be both helpful and harmful in visual perception.

Procedures/Activities/Instruction:

1. Have students complete the warm-up questions for section 1.1 on **BLM 1–4 Chapter 1 Warm-Up** to reinforce material learned previously.
2. Divide students into small groups. Provide the necessary supplies for them to carry out the Explore (pp. 6–7). Encourage students to use manipulatives such as rulers, Mira™, and mirrors. Once complete, have them discuss their findings as a class.
3. As a class, review the Link the Ideas (p. 7). Check that students are clear about the difference between the meanings of *line of symmetry* (p. 6) and *line symmetry* (p. 7). Use the visual of the Taj Mahal and other examples to help clarify understanding.
   Review Examples 1 and 2 (pp. 7–10). For Example 1, some students may find it easier to find the lines of symmetry using **BLM 1–6 Section 1.1 Example 1**. Some students may also find it easier to cut out the shapes on the blackline master and physically fold them to identify lines of symmetry. Encourage students to use the method (e.g., Mira™, peg boards, tissue paper, grid paper, folding) that they find easier to use.
   For Example 2, point out the Literacy Link that explains how to designate the positions of points after a transformation. Have students review each method before trying a method of their choice.
   Have students complete each Show You Know before going on.

Assessment:

1. Section 1.1 on **BLM 1–4 Chapter 1 Warm-Up** (Assessment *for* Learning)
2. Reflect and Check (p. 7) (Assessment *as* Learning)
3. Show You Know (pp. 8, 10) (Assessment *for* Learning)
4. Math Learning Log (Assessment *as* Learning)

Foldable Entry:

Have students define the following terms in their Foldable and draw an example of line symmetry.

line of symmetry line symmetry symmetric

Math Learning Log:

Have students explain using a diagram how a rectangle has only two lines of symmetry.

MathLinks 9 Chapter 1, Lesson 4

Time: 40–50 min

STRAND/ORGANIZER: Shape and Space (Transformations)

General Outcome: Describe and analyze position and motion of objects and shapes.

Specific Outcome:
SS5 Demonstrate an understanding of line and rotation symmetry.

Achievement Indicators:

- ☑ Classify a given set of 2-D shapes or designs according to the number of lines of symmetry.
- ☑ Complete a 2-D shape or design given one half of the shape or design and a line of symmetry.
- ☑ Identify and describe the types of symmetry created in a given piece of artwork.

Resources/Materials:

- *MathLinks 9,* pp. 11–15
- *MathLinks 9 Practice and Homework Book*, pp. 4–5
- Master 2 Communication Peer Evaluation
- BLM 1–7 Section 1.1 Extra Practice
- BLM 1–8 Section 1.1 Math Link
- grid paper or Master 8 Centimetre Grid Paper
- tracing paper
- ruler
- coloured pencils
- scissors
- glue or tape (optional)
- Mira™
- mirror
- Foldable

Teacher's Resource:
pp. 16–19

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
Review the Key Ideas as a class. Clarify any misunderstandings that students have. You may wish to draw a diagram on the board and prompt students to identify the line of symmetry. Ask:

- Does the diagram show line symmetry?
- Where is the line of symmetry?
- Are there any other lines of symmetry?

Reinforce the use of the terms *symmetric* and *symmetrical* as explained in the Literacy Link (p. 11). Explain to students that they will apply their knowledge of symmetry to solve problems.

Procedures/Activities/Instruction:

1. Challenge students to compare the terminology and examples in their Foldable to the material in the Key Ideas (p. 11). Is there anything they would like to add?
2. Assign and then collect students' response to Communicate the Ideas #3 (p. 12) to gain insight into their understanding. Direct students to the Literacy Link about parallelograms to help them visualize what is being asked. Collect their response for #3 to gain additional insight into students' understanding. Then assign, collect, and discuss student responses to #1 and 2. Have students use **Master 2 Communication Peer Evaluation** to assess another student's response to #2.
3. Assign questions as outlined in the Assessment section below. Ensure that students are successful with the Practise questions before proceeding to the Apply questions. Support for re-teaching or alternative approaches for students who are not successful with the Practise questions can be found in the Teacher's Resource under Assessment – Supporting Learning (p. 19).

Assessment:

1. Communicate the Ideas #1 and 2 (p. 11) (Assessment *as* Learning)
2. Student assignments (Assessment *for* Learning)

   Essential: #5–7, 9, 12, 15, Math Link
   Typical: #5, 7, 9, 10, 12–15, 16, 18, Math Link
   Extension/Enrichment: #20–23, Math Link

   Note: Some students may benefit from completing **BLM 1–7 Section 1.1 Extra Practice**, if they have not already done so.
   If students complete the assigned questions before the end of class, have them begin the Math Link (p. 15). **BLM 1–8 Section 1.1 Math Link** is available for students who may benefit from scaffolding to get started on the Math Link.
3. The *MathLinks 9 Practice and Homework Book* provides additional problems (Assessment *for* Learning).
4. Literacy Link (Assessment *as* Learning)
5. Math Learning Log (Assessment *as* Learning)

Foldable Entry:
Have students write the page reference and question numbers they had difficulty with in the What I Need to Work On section of their Foldable.

Literacy Link:
Have students complete the right circle of the thematic map and include definitions and examples for the terms *line symmetry* and *line of symmetry*. You might brainstorm as a class the information needed to complete the rectangle boxes and accompanying definitions.

Math Learning Log:
Have students compare the similarities and differences between the terminology used with line symmetry and that of reflections.

MathLinks 9 Chapter 1, Lesson 5

Time: 40–50 min

STRAND/ORGANIZER: Shape and Space (Transformations)

General Outcome: Describe and analyze position and motion of objects and shapes.

Specific Outcome:
SS5 Demonstrate an understanding of line and rotation symmetry.

Achievement Indicators:
- ☑ Determine if a given 2-D shape or design has rotation symmetry about the point at the centre of the shape or design and, if it does, state the order and angle of rotation.
- ☑ Rotate a given 2-D shape about a vertex and draw the resulting image.
- ☑ Identify the type of symmetry that arises from a given transformation on the Cartesian plane.
- ☑ Identify and describe the types of symmetry created in a given piece of artwork.

Resources/Materials:
- *MathLinks 9*, pp. 16–19
- BLM 1–4 Chapter 1 Warm-Up
- scissors
- tracing paper
- isometric dot paper or Master 7 Isometric Dot Paper
- grid paper or Master 8 Centimetre Grid Paper
- ruler
- coloured pencils (optional)
- paper clips (optional)
- Foldable

Teacher's Resource:
pp. 20–24

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
For teaching ideas and other activities for section 1.2, go to the ***MathLinks* 9 Lesson Planner and Program Overview Video**. In the main menu, select Section 1.2 Rotation Symmetry and Transformations. For ideas on teaching

section 1.2 using technology, in the main menu, select Linking Technology. Then, select Linking Technology to Section 1.2: Rotation Symmetry and Transformations.

As a class, read the opening paragraph. Tell students that they will examine the logo about population health to determine features of rotation symmetry. To begin, you might ask students to describe some visual characteristics of the logo. Rotations are often difficult for students, therefore it is important to provide sufficient hands-on time during the Explore.

Procedures/Activities/Instruction:

1. Have students complete the warm-up questions for section 1.2 on **BLM 1–4 Chapter 1 Warm-Up** to reinforce material learned previously. You may wish to review their work.
2. Collect, orally mark, or take up the previous day's homework. Remind students to note any questions they had difficulty with in the What I Need to Work On section of their Foldable.
3. Hand out tracing paper. Students may wish to use **Master 7 Isometric Dot Paper** or **Master 8 Centimetre Grid Paper** to complete the Explore (p. 16). Have students complete the Explore independently.
   Alternatively, you might provide students with a photocopy of the logo that has been copied to an overhead. This will reduce drawing time and allow for more time to discuss the activity. Encourage students to store the logo in the centre pocket of their Foldable. Depending on time constraints, encourage students to find another logo or design from brochures, magazines or newspapers, or the Internet for #3.
   Have students complete Reflect and Check #4 and compare their answers with those of a partner. Discuss the results as a class to gauge if students have understood the Explore or if further reinforcement is needed.
4. Work through Example 1, which explains order of rotation and angle of rotation (p. 17). Provide time for students to trace and then manipulate the shapes. Check that students can identify the location of the centre of rotation they are using. Alternatively, you might use an overhead and prepared copies of the shapes to demonstrate how to determine the angle of rotation. If so, provide time for students to trace and manipulate the shapes in the Show You Know. Review the number of degrees in one full rotation of a circle. Have students do the Show You Know and then discuss their response as a class. Such discussions support struggling learners who may be hesitant to ask questions.
   Colour is a powerful memory aid that helps students link and connect tasks. Some students may benefit from using colour as one of the identifiers for rotations. For instance, they might use a different colour to represent each order of rotation. Ask when using colour would not be a helpful indicator (when the order of rotation is 1).
   Work through Example 2 as a class (pp. 18–19) to determine the type of symmetry each figure demonstrates. The table presents the solution for

parts a) to c). Although it is not necessary to trace each shape, some students may benefit from tracing and manipulating each shape to help them visualize each rotation. For part d), you might explain that each shape is made by repeating a part of itself. Have students complete the Show You Know (p. 19) and discuss their conclusions orally. For Figure B, some students may benefit from rearranging paper clips to answer the question. Consider limiting the assignment to Figure A for students who benefit from the grid in the background to help see lines of symmetry.

Assessment:

1. Section 1.2 on **BLM 1–4 Chapter 1 Warm-Up** (Assessment *for* Learning)
2. Reflect and Check #4 (p. 16) (Assessment *as* Learning)
3. Show You Know (pp. 17, 19) (Assessment *for* Learning)
4. Math Learning Log (Assessment *as* Learning)

Foldable Entry:

Have students use their Foldable to define each of the following terms. Have them include their own example of rotation symmetry.

centre of rotation	rotation symmetry	order of rotation	angle of rotation

Math Learning Log:

Have students use diagrams on a coordinate grid to show how a shape and its translation demonstrate rotation symmetry.

MathLinks 9 Chapter 1, Lesson 6

Time: 40–50 min

STRAND/ORGANIZER: Shape and Space (Transformations)

General Outcome: Describe and analyze position and motion of objects and shapes.

Specific Outcome:
SS5 Demonstrate an understanding of line and rotation symmetry.

Achievement Indicators:

- ☑ Determine if a given 2-D shape or design has rotation symmetry about the point at the centre of the shape or design and, if it does, state the order and angle of rotation.
- ☑ Rotate a given 2-D shape about a vertex and draw the resulting image.
- ☑ Identify a line of symmetry or the order and angle of rotation symmetry in a given tessellation.
- ☑ Identify the type of symmetry that arises from a given transformation on the Cartesian plane.
- ☑ Complete, concretely or pictorially, a given transformation of a 2-D shape on a Cartesian plane, record the coordinates and describe the type of symmetry that results.
- ☑ Identify and describe the types of symmetry created in a given piece of artwork.
- ☑ Determine whether or not two given 2-D shapes on the Cartesian plane are related by either rotation or line symmetry.
- ☑ Draw, on a Cartesian plane, the translation image of a given shape using a given translation rule, such as R2, U3 or $\rightarrow \rightarrow$,$\uparrow \uparrow \uparrow$, label each vertex and its corresponding ordered pair and describe why the translation does not result in line or rotation symmetry.
- ☑ Create or provide a piece of artwork that demonstrates line and rotation symmetry, and identify the line(s) of symmetry and the order and angle of rotation.

Resources/Materials:

- *MathLinks 9,* pp. 20–25
- *MathLinks 9 Practice and Homework Book*, pp 6–7
- Master 2 Communication Peer Evaluation
- BLM 1–9 Section 1.2 Extra Practice
- BLM 1–10 Section 1.2 Math Link
- grid paper or Master 8 Centimetre Grid Paper
- tracing paper

- ruler
- coloured pencils
- scissors
- tracing paper
- Foldable

Teacher's Resource:
pp. 25–28

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
As a class, discuss the Key Ideas (p. 20). Take up any questions students have and invite them to add any missing vocabulary and concepts to their Foldable. Tell students they will apply their learning about rotation symmetry to solve problems.

Procedures/Activities/Instruction:
1. Assign and then collect all students' individual work for Communicate the Ideas #1 to 3 (p. 20). You may wish to use Communicate the Ideas #2 (p. 20) as an Assessment *for* Learning. As a class, discuss the responses to the questions. Have students use **Master 2 Communication Peer Evaluation** to assess another student's response to #1.
2. Assign questions as outlined in the Assessment section below. Make **Master 8 Centimetre Grid Paper** and tracing paper available. For #11, direct students to the Literacy Link to clarify the term *tessellation*. Ensure that students are successful with the Practise questions before proceeding to the Apply questions. Support for re-teaching or alternative approaches for students who are not successful with the Practise questions can be found in the Teacher's Resource under Assessment – Supporting Learning (p. 28).

Assessment:
1. Communicate the Ideas #1 to 3 (p. 20) (Assessment *as* Learning)
2. Student assignments (Assessment *for* Learning)

   Essential: #4, 7, 9, 10, 12, 16, Math Link
   Typical: #4, 7, 9–12, 16, 17, 19, Math Link
   Extension/Enrichment: #10, 17–26, Math Link

   This assignment is likely to take more than one class as students will draw several designs.
   Note: Some students may benefit from completing **BLM 1–9 Section 1.2 Extra Practice**, if they have not already done so.
   If students complete the assigned questions before the end of class, have them begin the Math Link (p. 25). **BLM 1–10 Section 1.2 Math Link** is available for students who may benefit from scaffolding to get started on the Math Link.

3. The *MathLinks 9 Practice and Homework Book* provides additional problems (Assessment *for* Learning).
4. Literacy Link (Assessment *as* Learning)
5. Math Learning Log (Assessment *as* Learning)

Foldable Entry:
Have students write the page reference and question numbers they had difficulty with in the What I Need to Work On section of their Foldable.

Literacy Link:
Have students complete the left circle of the thematic map and include definitions and examples for the terms *order*, *angle*, and *centre of rotation*. You might brainstorm as a class the information needed to complete the rectangle boxes and accompanying definitions.

Math Learning Log:
Have students comment on two or three items they feel they have improved on and explain how they have improved.

MathLinks 9 Chapter 1, Lesson 7

Time: 40–50 min

STRAND/ORGANIZER: Shape and Space (3-D Objects and 2-D Shapes) (Transformations)

General Outcomes: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Describe and analyze position and motion of objects and shapes.

Specific Outcomes:

SS2 Determine the surface area of composite 3-D objects to solve problems.

SS5 Demonstrate an understanding of line and rotation symmetry.

Achievement Indicators:

- ☑ Determine the area of overlap in a given concrete composite 3-D object, and explain its effect on determining the surface area (limited to right cylinders, right rectangular prisms and right triangular prisms).
- ☑ Determine the surface area of a given concrete composite 3-D object (limited to right cylinders, right rectangular prisms and right triangular prisms).
- ☑ Solve a given problem involving surface area.

Resources/Materials:

- *MathLinks 9*, pp. 26–31
- BLM 1–4 Chapter 1 Warm-Up
- grid paper or Master 8 Centimetre Grid Paper
- small disks or pennies
- small boxes or dominoes
- centimetre cubes (optional)
- ruler
- calculator
- interlocking cubes
- Foldable

Teacher's Resource:

pp. 29–35

***MathLinks 9* Adapted Resource:**

See corresponding chapter for adapted materials to support individual students.

Introduction:
For teaching ideas and other activities for section 1.3, go to the ***MathLinks* 9 Lesson Planner and Program Overview Video**. In the main menu, select Section 1.3 Surface Area. For ideas on teaching section 1.3 using technology, in the main menu, select Linking Technology. Then, select Linking Technology to Section 1.3: Surface Area.

Read the opening paragraph about red blood cells (p. 26). You might review the importance of the red blood cells in carrying oxygen to body cells. Explain that red blood cells are shaped in such a way as to maximize the amount of oxygen that can attach to these cells. Anything that decreases the exposed surface area will reduce the amount of oxygen that can be carried to body cells.

In the Explore, students explore symmetry and surface area by comparing the surface area of individual cylinders and prisms to stacks of solids. Students have worked with area and surface area and the Pythagorean relationship in previous math courses, but perhaps not linked with composite shapes. Point out the Literacy Link that explains the meaning of a *composite object*. You may need to help students recall area formulas or refer them to the Get Ready to reactivate their previous knowledge. Encourage students to write the formulas in their Foldable for easy reference.

Procedures/Activities/Instruction:
1. Have students complete the warm-up questions for section 1.3 on **BLM 1–4 Chapter 1 Warm-Up** to reinforce material learned previously.
2. Collect, orally mark, or take up the previous day's homework. Remind students to note any question they had difficulty with in the What I Need to Work On section of their Foldable.
3. Provide the materials needed to model the cylinders and prisms in the Explore. For #3, you might provide fabric or paper and wooden BBQ skewers to model the tent. Have students complete the Explore with a partner and then compare answers with another student pair before discussing the results as a class. Have them list questions or concepts they are having difficulty with in the What I Need to Work On section of their Foldable.
4. As a class, discuss the Link the Ideas, which explains using one formula that works for surface area of both a cylinder and a rectangular prism. Encourage students to add a note to their Foldable. Using an actual box, remove the lid and have students discuss how that would change the surface area of the box. Example 1 (p. 28) provides an opportunity for students to calculate the surface area of a rectangular prism and then determine the effect on surface area when a section is removed. Students may benefit from using solids, such as centimetre cubes, to model the situation and then develop their own solution before reading through the worked solution. Alternatively, depending on the time of year, you might have them create a model of a gingerbread house and calculate the surface area of the house to be decorated.

Discuss the Did You Know? (p. 29) and ensure that students understand why the surface area of Figure 3 is less than the surface areas of Figures 1 and 2, which are the same. Have students record a summary using their own words and diagrams in their Foldable or Math Learning Log.

Example 2 (p. 29) models calculating the surface area of a bookcase to be painted. Some students may benefit from building a model of the bookcase and then working through the solution, paying careful attention to the thought bubbles to avoid common errors.

Have students complete the Show You Know questions (pp. 29, 30) with a partner and then share their solutions with the class. You might consider substituting different objects for the concrete steps and the building.

5. As a class, discuss the Key Ideas. Encourage students to make their own summary of using symmetry to determine surface area and add it to their Foldable.
6. Assign and then collect all students' individual work for Communicate the Ideas #1 to 3 (p. 31).

Assessment:

1. Section 1.3 on **BLM 1–4 Chapter 1 Warm-Up** (Assessment *for* Learning)
2. Reflect and Check #4 and 5 (p. 27) (Assessment *as* Learning)
3. Show You Know (pp. 29, 30) (Assessment *for* Learning)
4. Communicate the Ideas #1 to 3 (Assessment *as* Learning)
5. Math Learning Log (Assessment *as* Learning)

Foldable Entry:

Have students define the following terms in their Foldable. For surface area, have them add to their earlier definition by explaining how to use symmetry to calculate surface area.

surface area composite object

Math Learning Log:

Have students complete the following statement: Identifying overlapping pieces when determining surface area is important because …

MathLinks 9 Chapter 1, Lesson 8

Time: 40–50 min

STRAND/ORGANIZER: Shape and Space (3-D Objects and 2-D Shapes) (Transformations)

General Outcomes: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Describe and analyze position and motion of objects and shapes.

Specific Outcomes:

SS2 Determine the surface area of composite 3-D objects to solve problems.

SS5 Demonstrate an understanding of line and rotation symmetry.

Achievement Indicators:

- ☑ Determine the area of overlap in a given concrete composite 3-D object, and explain its effect on determining the surface area (limited to right cylinders, right rectangular prisms and right triangular prisms).
- ☑ Determine the surface area of a given concrete composite 3-D object (limited to right cylinders, right rectangular prisms and right triangular prisms).
- ☑ Solve a given problem involving surface area.

Resources/Materials:

- *MathLinks 9,* pp. 32–35
- *MathLinks 9 Practice and Homework Book*, pp. 8–9
- Master 2 Communication Peer Evaluation
- BLM 1–11 Section 1.3 Extra Practice
- BLM 1–12 Section 1.3 Math Link
- dot paper or Master 7 Isometric Dot Paper
- ruler
- centimetre cubes
- decks of playing cards, memo pads, business cards, notepads (optional)
- Foldable

Teacher's Resource:

pp. 35–38

***MathLinks 9* Adapted Resource:**

See corresponding chapter for adapted materials to support individual students.

Introduction:
Begin the class with an oral recall of how to find the surface area of a composite object. Ask how symmetry can help with the calculations.

Students will apply their understanding of symmetry and surface area.

Procedures/Activities/Instruction:
1. As a class, discuss the response to the Communicate the Ideas questions. Have students use **Master 2 Communication Peer Evaluation** to assess another student's response to #3. Remind students to note any question they had difficulty with in the What I Need to Work On section of their Foldable.
2. Assign questions as outlined in the Assessment section below. Encourage students to model #4 using centimetre cubes. Ensure that students are successful with the Practise questions before proceeding to the Apply questions. Support for re-teaching or alternative approaches for students who are not successful with the Practise questions can be found in the Teacher's Resource under Assessment – Supporting Learning (p. 38).

Assessment:
1. Student assignments (Assessment *for* Learning)
   Essential: #4, 6, 8, 10, 12, 18, Math Link
   Typical: #4, 6, 8, 10, 12, one of 13 *or* 14, one of 16–19, Math Link
   Extension/Enrichment: #14, 17, 20–23
   Note: Some students may benefit from completing **BLM 1–11 Section 1.3 Extra Practice**, if they have not already done so.
   If students complete the assigned questions before the end of class, have them begin the Math Link (p. 35). Provide decks of playing cards, memo pads, business cards, and notepads so students can take measurements for surface area calculations. **BLM 1–12 Section 1.3 Math Link** is available for students who may benefit from scaffolding to get started on the Math Link.
2. The *MathLinks 9 Practice and Homework Book* provides additional questions or replacement questions (Assessment *for* Learning).
3. Literacy Link (Assessment *as* Learning)
4. Math Learning Log (Assessment *as* Learning)

Foldable Entry:
Have students write the page reference and question numbers they had difficulty with in the What I Need to Work On section of their Foldable.

Literacy Link:
Have students complete the bottom circle of the thematic map and include definitions and examples for the terms introduced in this section. You might brainstorm as a class the information needed to complete the rectangle boxes and accompanying definitions.

Math Learning Log:
Have students complete the following statement: The similarities and differences between finding surface area of a composite object and a rectangular prism are ...

STRAND/ORGANIZER: Shape and Space (3-D Objects and 2-D Shapes) (Transformations)

General Outcomes: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Describe and analyze position and motion of objects and shapes.

Specific Outcomes:

SS2 Determine the surface area of composite 3-D objects to solve problems.

SS5 Demonstrate an understanding of line and rotation symmetry.

Achievement Indicators:

- ☑ Determine the area of overlap in a given concrete composite 3-D object, and explain its effect on determining the surface area (limited to right cylinders, right rectangular prisms and right triangular prisms).
- ☑ Determine the surface area of a given concrete composite 3-D object (limited to right cylinders, right rectangular prisms and right triangular prisms).
- ☑ Solve a given problem involving surface area.
- ☑ Classify a given set of 2-D shapes or designs according to the number of lines of symmetry.
- ☑ Complete a 2-D shape or design given one half of the shape or design and a line of symmetry.
- ☑ Determine if a given 2-D shape or design has rotation symmetry about the point at the centre of the shape or design and, if it does, state the order and angle of rotation.
- ☑ Rotate a given 2-D shape about a vertex and draw the resulting image.
- ☑ Identify a line of symmetry or the order and angle of rotation symmetry in a given tessellation.
- ☑ Identify the type of symmetry that arises from a given transformation on the Cartesian plane.
- ☑ Complete, concretely or pictorially, a given transformation of a 2-D shape on a Cartesian plane, record the coordinates and describe the type of symmetry that results.
- ☑ Identify and describe the types of symmetry created in a given piece of artwork.
- ☑ Determine whether or not two given 2-D shapes on the Cartesian plane are related by either rotation or line symmetry.
- ☑ Draw, on a Cartesian plane, the translation image of a given shape using a given translation rule, such as R2, U3 or $\rightarrow \rightarrow$, $\uparrow \uparrow \uparrow$, label each vertex and its corresponding ordered pair and describe why the

translation does not result in line or rotation symmetry.

Resources/Materials:
- *MathLinks 9* pp. 36–37
- *MathLinks 9 Practice and Homework Book*, pp. 10–13
- BLM 1–5 Chapter 1 Problems of the Week
- BLM 1–7 Section 1.1 Extra Practice
- BLM 1–9 Section 1.2 Extra Practice
- BLM 1–11 Section 1.3 Extra Practice
- isometric dot paper or Master 7 Isometric Dot Paper
- grid paper or Master 8 Centimetre Grid Paper
- centimetre or interlocking cubes
- ruler
- coloured pencils
- Foldable

Teacher's Resource:
pp. 39–40

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
Students are now at the chapter review, which serves as a self-assessment tool.

For additional information about the chapter review, go to the ***MathLinks* 9 Lesson Planner and Program Overview Video**. In the main menu, select Chapter 1 Review, Practice Test and Wrap It Up!

Procedures/Activities/Instruction:
1. Decide how you wish students to approach the Chapter 1 Review. The review is an opportunity for students to verify that they have mastered the concepts and identify any areas of weakness prior to any Assessment *of* Learning. There are a number of approaches that could be used, including:
   - Have students use the notes they made in the What I Need to Work On section of their Foldable to identify any areas of weakness and to help them select review questions.
   - Have students complete at least one related item from each section.
   - Have students revisit their assignments, identify areas of weakness, and select review questions accordingly.
   - As the teacher, you might select the questions to be completed by the class or individual students.
   - Have students complete the Challenge: Making a Paper Airplane (p. 40), which provides reinforcement of the chapter concepts.

- If students have the *MathLinks 9 Practice and Homework Book*, have them complete questions from the relevant sections. Additionally, you might have them complete the Chapter Link and the Vocabulary Link (pp. 10–11) to reinforce their learning. You may wish to use the Chapter 1 Review (pp. 12–13) for review purposes before students write the chapter test or as a refresher if you decide to test content from Chapter 1 in later chapter tests.
- You may wish to use questions from **BLM 1–7 Section 1.1 Extra Practice**, **BLM 1–9 Section 1.2 Extra Practice**, and **BLM 1–11 Section 1.3 Extra Practice**.

Assessment:

1. Chapter 1 Review (Assessment *for* Learning). Students may benefit from using **Master 7 Isometric Dot Paper** and **Master 8 Centimetre Grid Paper** as they work through the review. Consider assigning #7a), 9, 10b), 12, and 14–17, which are the minimum questions that will meet the curriculum outcomes. Assignments should be completed within class time in order for students to get assistance.
2. Challenge: Making a Paper Airplane (p. 41) (Assessment *for* Learning)

Foldable Entry:

Encourage students to use the terminology in their Foldable. As they do the review, they could note what areas in the What I Need to Work On section they now understand. This is a good opportunity for students to note personal growth.

Problems of the Week:

This may be a good time to discuss students' responses to **BLM 1–5 Chapter 1 Problems of the Week**.

MathLinks 9 Chapter 1, Lesson 10

Time: 40–50 min

STRAND/ORGANIZER: Shape and Space (3-D Objects and 2-D Shapes) (Transformations)

General Outcomes: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Describe and analyze position and motion of objects and shapes.

Specific Outcomes:

SS2 Determine the surface area of composite 3-D objects to solve problems.

SS5 Demonstrate an understanding of line and rotation symmetry.

Achievement Indicators:

- ☑ Determine the area of overlap in a given concrete composite 3-D object, and explain its effect on determining the surface area (limited to right cylinders, right rectangular prisms and right triangular prisms).
- ☑ Determine the surface area of a given concrete composite 3-D object (limited to right cylinders, right rectangular prisms and right triangular prisms).
- ☑ Solve a given problem involving surface area.
- ☑ Determine if a given 2-D shape or design has rotation symmetry about the point at the centre of the shape or design and, if it does, state the order and angle of rotation.
- ☑ Identify a line of symmetry or the order and angle of rotation symmetry in a given tessellation.
- ☑ Identify the type of symmetry that arises from a given transformation on the Cartesian plane.
- ☑ Determine whether or not two given 2-D shapes on the Cartesian plane are related by either rotation or line symmetry.

Resources/Materials:

- *MathLinks 9*, pp. 38–39
- BLM 1–12 Chapter 1 Test
- isometric dot paper or Master7 Isometric Dot Paper
- grid paper or Master 8 Centimetre Grid Paper
- ruler
- coloured pencils
- centimetre cubes
- calculator (optional)
- Foldable

Teacher's Resource:
pp. 41–42

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
Students are now at the practice test. This could serve as a self-assessment tool or as a summative tool.

For additional information about the practice test, go to the ***MathLinks* 9 Lesson Planner and Program Overview Video**. In the main menu, select Chapter 1 Review, Practice Test and Wrap It Up!

Procedures/Activities/Instruction:
1. Before completing the Chapter 1 Practice Test, have students review and complete their thematic map.
2. Decide how you wish students to approach the practice test. Practice tests are opportunities for students to verify that they have mastered the concepts and identify any areas of weakness prior to Assessment *of* Learning. Provide students with a number of questions that they can comfortably do in one class. Choose at least one question for each concept, skill, or process. Provide centimetre cubes for #9. Make **Master 7 Isometric Dot Paper** and **Master 8 Centimetre Grid Paper** available for students to use.
3. You may wish to use **BLM 1–13 Chapter 1 Test** or items from the computerized assessment bank (CAB) as a summative assessment.

Assessment:
1. Chapter 1 Practice Test (pp. 38–39) (Assessment *for* Learning). The essential questions to meet the curriculum requirements are #1–8, and 10. Assignments should be completed within class time in order to allow students to get assistance.
2. **BLM 1–12 Chapter 1 Test** (Assessment *of* Learning)

Foldable Entry:
Encourage students to use their Foldable for terminology, and to note areas of personal growth.

MathLinks 9 Chapter 1, Lesson 11

Time: 40–50 min

STRAND/ORGANIZER: Shape and Space (3-D Objects and 2-D Shapes) (Transformations)

General Outcomes: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Describe and analyze position and motion of objects and shapes.

Specific Outcomes:

SS2 Determine the surface area of composite 3-D objects to solve problems.

SS5 Demonstrate an understanding of line and rotation symmetry.

Achievement Indicators:

- ☑ Determine the surface area of a given concrete composite 3-D object (limited to right cylinders, right rectangular prisms and right triangular prisms).
- ☑ Solve a given problem involving surface area.
- ☑ Identify and describe the types of symmetry created in a given piece of artwork.
- ☑ Create or provide a piece of artwork that demonstrates line and rotation symmetry, and identify the line(s) of symmetry and the order and angle of rotation.

Resources/Materials:

- *MathLinks 9*, p. 39
- Master 1 Project Rubric
- BLM 1–14 Chapter 1 Math Link: Wrap It Up!
- poster paper
- markers
- coloured pencils
- PowerPoint (optional)
- centimetre cubes (optional)
- clear plastic wrap (optional)
- Foldable

Teacher's Resource:

pp. 43–44

***MathLinks 9* Adapted Resource:**

See corresponding chapter for adapted materials to support individual students.

Introduction:
Students will complete the chapter problem Math Link: Wrap It Up! (p. 39), which allows them to demonstrate their understanding of symmetry and surface area. Their work on the Math Links throughout the chapter will help them with this process.

For additional information about the Math Link: Wrap It Up!, go to the ***MathLinks* 9 Lesson Planner and Program Overview Video**. In the main menu, select Chapter 1 Review, Practice Test and Wrap It Up!

Procedures/Activities/Instruction:
1. Decide and communicate how much class time students will have to complete the Math Link: Wrap It Up!
2. Read through the Math Link: Wrap It Up! and discuss design options. You might encourage students to model the solution for part d) using centimetre cubes wrapped in plastic. Remind them to use their previous work on the Math Links. Emphasize the importance of addressing all parts of the question. **BLM 1–14 Chapter 1 Math Link: Wrap It Up!** provides scaffolding for students who need help to get started.
3. It is important for students to understand how they will be graded. Provide each student with **Master 1 Project Rubric**. Clarify the assessment criteria using the master rubric or the version of the rubric in the Teacher's Resource (p. 44). Work with students to develop the expected outcomes for each level. If using the rubric in the Teacher's Resource, delete the content in the column with the specific question notes and work with students to complete the expected outcomes for each level. Completing specific question notes in this way allows students to identify the key criteria for each level. At the same time, you might emphasize the criteria that differentiate different levels (e.g., Level 3 and Level 4), in an effort to encourage students to improve their performance.

Assessment:
1. **Master 1 Project Rubric** (Assessment *of* Learning)

Foldable Entry:
Encourage students to refer to their Foldable as they practise using appropriate mathematical terminology.

MathLinks 9 Chapter 1, Lesson 12

Time: 90–130 min

STRAND/ORGANIZER: Shape and Space (3-D Objects and 2-D Shapes) (Transformations)

General Outcomes: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Describe and analyze position and motion of objects and shapes.

Specific Outcomes:

SS2 Determine the surface area of composite 3-D objects to solve problems.

SS5 Demonstrate an understanding of line and rotation symmetry.

Achievement Indicators:

- ☑ Determine the surface area of a given concrete composite 3-D object (limited to right cylinders, right rectangular prisms and right triangular prisms).
- ☑ Solve a given problem involving surface area.
- ☑ Identify and describe the types of symmetry created in a given piece of artwork.
- ☑ Create or provide a piece of artwork that demonstrates line and rotation symmetry, and identify the line(s) of symmetry and the order and angle of rotation.

Resources/Materials:

Challenges	
Making a Paper Airplane	**Musical Instruments**
MathLinks 9, p. 40 50–80 min • Master 1 Project Rubric • grid paper or Master 8 Centimetre Grid Paper (optional) • ruler • scissors • Foldable	*MathLinks 9*, p. 41 40–50 min • Master 1 Project Rubric • dot paper or Master 7 Isometric Dot Paper • grid paper or Master 8 Centimetre Grid Paper

Teacher's Resource:

pp. 45–50

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
Both Challenges allow students to apply their understanding of symmetry and surface area.

Procedures/Activities/Instruction:
Making a Paper Airplane

1. Read through the Challenge with students and make sure they understand what is expected.
2. Clarify that the task is to:
   - investigate how surface area affects the distance and direction travelled
   - investigate the distance and direction travelled by a symmetrical and a non-symmetrical paper airplane
   - use knowledge of surface area and symmetry to design a plane that is functional.

   You might encourage students to use **Master 8 Centimetre Grid Paper** and trace the wing surface in order to calculate its surface area. Refer to the Teacher's Resource for additional suggestions for this Challenge.
3. If you use the Challenge for Assessment *of* Learning, it is important that students understand how they will be graded. Review **Master 1 Project Rubric** or use the version in the Teacher's Resource (p. 47) and work with students to develop the expected outcomes for each level. If using the version in the Teacher's Resource, delete the content in the column with the specific question notes and work with students to complete the expected outcomes for each level. Completing specific question notes in this way allows students to identify the key criteria for each level. At the same time, you might emphasize the criteria that differentiate different levels (e.g., Level 3 and Level 4), in an effort to encourage students to improve their performance.

Musical Instruments
Note: You may need to book the computer lab in advance for students to research musical instruments. Alternatively, provide magazines that students can use to cut out pictures of musical instruments.

1. Read through the Challenge with students and make sure they understand what is expected.
2. Clarify that the task is to:
   - find a picture of or draw a musical instrument that has one or more lines of symmetry
   - draw in the lines of symmetry
   - describe any rotational symmetry present in the instrument
   - explain the role of symmetry in the design of the instrument
   - choose an instrument that can be represented as composite shapes
   - sketch this instrument and approximate the surface area

Encourage students to use **Master 7 Isometric Dot Paper** to sketch the instruments and **Master 8 Centimetre Grid Paper** to draw nets of the various shapes in their instrument. Refer to the Teacher's Resource for additional suggestions for this Challenge.

3. If you use the Challenge for Assessment *of* Learning, it is important that students understand how they will be graded. Review **Master 1 Project Rubric** or use the version in the Teacher's Resource (p. 50) and work with students to develop the expected outcomes for each level. If using the version in the Teacher's Resource, delete the content in the column with the specific question notes and work with students to complete the expected outcomes for each level. Completing specific question notes in this way allows students to identify the key criteria for each level. At the same time, you might emphasize the criteria that differentiate different levels (e.g., Level 3 and Level 4), in an effort to encourage students to improve their performance.

Assessment:

1. You may decide to let students choose either Challenge, depending on the type of assessment you are looking for (Assessment *of* Learning or Assessment *for* Learning).

Foldable Entry:

Encourage students to use their Foldable to help them use mathematical terminology appropriately.