Musical Instruments

1. Find pictures of, or draw musical instruments of your choice. Draw in the lines of symmetry. Describe any rotation symmetry present.

2. Explain the role symmetry plays in the design of your selected musical instruments.

3. Select a musical instrument that can be roughly represented as a composite shape formed by
   - right cylinders
   - right rectangular prisms, and/or
   - right triangular prisms

   Determine the surface area of the representation to approximate the surface area of the instrument. Show your thinking.

Challenges • MHR 41

Planning Notes: Musical Instruments

You may wish to use the following steps to introduce and complete this Challenge:

1. If your school has a band, borrow an instrument. If not, find a picture of an instrument, refer to the pictures in the student resource, or see if you can get a student to bring in a drum or guitar.
- Ask students to point out where lines of symmetry exist in the instrument. You may wish to discuss both the lines of symmetry present in two-dimensional views of the instrument and lines of symmetry through the three-dimensional instrument. Also, discuss and find any rotational symmetry that the instrument may have.
- If the instrument as a whole does not have lines of symmetry or rotational symmetry, you may wish to look for symmetry in a part of the instrument. For example, in many brass and woodwind instruments, the bell of the horn has both lines of symmetry and rotational symmetry.

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Suggested Timing
40–50 minutes

Blackline Masters
Master 1 Project Rubric
Master 7 Isometric Dot Paper
Master 8 Centimetre Grid Paper

Mathematical Processes
- ☑ Communication (C)
- ☑ Connections (CN)
- ☑ Mental Mathematics and Estimation (ME)
- ☑ Problem Solving (PS)
- ☑ Reasoning (R)
- ☐ Technology (T)
- ☑ Visualization (V)

Specific Outcomes
SS2 Determine the surface area of composite 3-D objects to solve problems.
SS5 Demonstrate an understanding of line and rotation symmetry.

2. Read the Challenge with the class. Discuss why a musical instrument is symmetrical or made of symmetrical parts. Ask:
- What instrument might you select to answer #1?
- How does symmetry play a role in the design of this instrument?
- What instrument might you select to answer #3? (Examples are drums, piano, organ, keyboard, bells, maraca, recorder, bamboo flute, and xylophone.)
- How might drawing a net help approximate the surface area of this instrument?

3. 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

4. Review **Master 1 Project Rubric** with students so that they will know what is expected.

Meeting Student Needs

- Encourage students to find an instrument from a particular culture or country that interests them.
- Some students may choose an instrument for which it would be too difficult to make a composite figure from cylinders, rectangular prisms, and/or triangular prisms. Encourage them to choose an instrument in which the composite shapes are clearer.
- Students with limited ability to see spatially would greatly benefit from actually seeing and touching the instrument they are using to answer questions.
- Students may wish to use **Master 7 Isometric Dot Paper** to sketch their instrument(s).
- Students may wish to use **Master 8 Centimetre Grid Paper** to draw nets of the various shapes in their instruments.

Gifted and Enrichment

- Have students explain how the instrument they chose is made, how it is played, and other interesting information.
- Have students research the history of their instrument, including how the design, shape, materials it is constructed from, and its use, have changed over time. If applicable, have them discuss how and why the symmetry has changed.

This Challenge can be used for either Assessment *for* Learning or Assessment *of* Learning.

Assessment	Supporting Learning
Assessment *for* Learning	
Musical Instruments Discuss the Challenge as a class. Have students provide individual responses.	• Consider allowing students to work with a partner and then write individual responses.
Assessment *of* Learning	
Musical Instruments Introduce the Challenge to the class. Have students provide individual responses.	• **Master 1 Project Rubric** provides a holistic descriptor that will assist you in assessing student work on this Challenge. Page 50 provides notes on how to use the rubric for this Challenge. • To view student exemplars, go to www.mathlinks9.ca, access the Teacher Centre on the Online Learning Centre, go to Assessment, and then follow the links.

The chart below shows the **Master 1 Project Rubric** for tasks such as this Challenge, Musical Instruments, and provides notes that specify how to identify the level of specific answers for this project.

Score/Level	Holistic Descriptor	Specific Question Notes
5 **(Standard of Excellence)**	❑ Applies/develops **thorough** strategies and mathematical processes making **significant** comparisons/connections that demonstrate a **comprehensive** understanding of how to develop a complete solution ❑ Procedures are **efficient and effective** and may contain a **minor mathematical error** that does not affect understanding ❑ Uses **significant** mathematical language to explain their understanding and provides **in-depth** support for their conclusion	• provides a complete and correct solution
4 **(Above Acceptable)**	❑ Applies/develops **thorough** strategies and mathematical processes for making **reasonable** comparisons/connections that demonstrate a **clear** understanding ❑ Procedures are **reasonable** and may contain a **minor mathematical error** that may hinder the understanding in one part of a complete solution ❑ Uses **appropriate** mathematical language to explain their understanding and provides **clear** support for their conclusion	Demonstrates one of the following: • provides a complete response to all parts of the question; response contains a calculation error in the surface area, which affects the overall results • provides a complete response to the question, with missing justification • provides a complete response, with weak communication
3 **(Meets Acceptable)**	❑ Applies/develops **relevant** strategies and mathematical processes making **some** comparisons/connections that demonstrate a **basic** understanding ❑ Procedures are **basic** and may contain a **major error or omission** ❑ Uses **common** language to explain their understanding and provides **minimal** support for their conclusion	Demonstrates one of the following: • provides a correct and complete response to #1 and 2, with an appropriate instrument identified or drawn representing a composite shape; correctly calculates the area of parts of the composite shape but does not complete the calculation • provides a complete response in which the student draws a net for #3 but inaccurately represents the shape and calculates the surface area incorrectly
2 **(Below Acceptable)**	❑ Applies/develops **some relevant** mathematical processes making **minimal** comparisons/connections that lead to a **partial solution** ❑ Procedures are **basic** and may contain **several major mathematical errors** ❑ Communication is **weak**	Demonstrates one of the following: • provides a correct response to #1 and 2 • provides a correct response to #2 and a correct step in calculating the surface area of their instrument
1 **(Beginning)**	❑ Applies/develops an **initial start** that may be **partially correct** or could have led to a correct solution ❑ Communication is **weak or absent**	Demonstrates one of the following: • identifies a pictures or pictures that display symmetry although the student may not draw the lines in; the description is not attempted • provides a correct response to #2

For student exemplars, go to www.mathlinks9.ca and follow the links.