Unit 16  Geometry: 3-D Shapes

Introduction

In this unit, students will identify and create shapes with horizontal and vertical symmetry. They will identify, describe, compare, and manipulate cubes, rectangular prisms, cones, cylinders, and spheres. They will identify similarities and differences between objects in the environment and 3-D shapes. Students will compose and decompose structures using 3-D shapes. They will describe the relative location of objects in the environment, in structures, and on concrete maps (e.g., above, below, beside, between).

Meeting Your Curriculum

Alberta—Lessons G1-15 to G1-19 are required. All other lessons in this unit are optional.

British Columbia—Lessons G1-14 and G1-20 are optional. All other lessons in this unit are required.

Manitoba—Lessons G1-15 to G1-19 are required. All other lessons in this unit are optional.

Ontario—All lessons in this unit are required.

Vocabulary. The most important terms in this unit are the location words (on top of, inside, beside, in front of, behind, under, and between) and the names of 3-D shapes (cube, rectangular prism, sphere, cylinder, and cone). You can add the pictures from BLM Location Picture Cards (p S-52) to your word wall, labelled: on top of the box, inside the box, beside the box, in front of the box, behind the box, under the table, and between the box and the table. You can also make cards for the 3-D shape names by using pictures along with the names of the shapes.

We use the words “inside” and “outside,” but you can also use the words “in” and “out.”

We use “has symmetry” to specifically mean a shape has a vertical or horizontal line (or plane) of symmetry. We disregard other forms of symmetry at this grade level.

We use the terms rectangular prism, cone, and cylinder to refer to right rectangular prisms, right cones, and right cylinders. We also use the words cube, prism, cone, and cylinder, even when the shape is open, such as an open box, an ice cream cone, or a paper towel tube.

Cubes are a special case of rectangular prisms. While students are not expected to know this, we recommend using correct language when referring to cubes. For example, if you ask students to name the shape of a cube and they say “rectangular prism,” tell them they are correct, but there is also another name for this shape because all the faces are squares. Do not say: “No, this is a cube, not a rectangular prism” as that is incorrect—all cubes are also rectangular prisms.
Note also that we define the word “corner” in Lesson G1-18. However, students may use the word informally earlier, when comparing objects that look like cubes to actual cubes, as in “some dice have rounded corners.”

Your students may have the opportunity to go on a field trip after finishing this unit. If so, ask them to look for 3-D shapes in the environment as they explore. Do they see cubes, other rectangular prisms, spheres, cylinders, and cones? Do they see any flat and curved faces? Do they see any objects in the environment that have symmetry (i.e., that look like they match on the left and right, or on the top and bottom, or at the front and back)? Encourage students to use location words when they describe where they see the shapes or what parts match exactly when seeing symmetry.

Materials. You will need lots of each of the basic 3-D shapes: cubes, other rectangular prisms, spheres, cylinders, and cones. To do all the exercises and essential activities, you will need at least six of each 3-D shape, or one for every five students, whichever is greater, preferably of different sizes and colours. You will also need small cubes (e.g., connecting cubes), enough for each student to have one.

If you do not have commercial sets of 3-D shapes, you can create shapes from BLM Nets for Cubes (pp S-42–44), BLM Nets for Prisms (pp S-45–46), BLM Nets for Cylinders (pp S-47–48), and BLM Nets for Cones (p S-49). The cylinders and cones have matching circles of three different sizes. We recommend using cardstock to make sturdier shapes. Use different colours for each shape if available. Note that it is not realistic to ask students at this age to create these shapes from nets, but you may wish to ask older students to help. To make cutting out the nets easier, you might wish to omit the tabs.

Alternatively, you can make 3-D shapes from modelling clay or dough. Students will create shapes from clay in the activities. You can use these shapes in later activities by keeping them in airtight containers or using clay that air dries without crumbling.

You will also need real world examples of the basic 3-D shapes. You may be able to borrow balls from the gym. You can ask parents to send in objects, such as those listed in the Letter to Parents (p S-68) or bring in objects yourself from home.

Lesson G1-19 requires more specific sizes of shapes. Before the lesson, make sure you have the following shapes:

- 2 large, 5 medium, and 2 small cubes (see BLM Nets for Cubes)
- 2 large, 2 medium, and 4 small cylinders (see BLM Nets for Cylinders)
- 2 large, 2 medium, and 2 small cones (see BLM Nets for Cones)
- 2 large, 2 medium, and 2 small rectangular prisms (see BLM Nets for Prisms)
- 6 spheres of different sizes and colours
We recommend having six classroom bins to store each of the different shapes. Label the bins: “cubes,” “rectangular prisms (not cubes),” “spheres,” “cylinders,” “cones,” and “other shapes.” Include pictures on the labels. Students will be sorting shapes throughout this unit. We recommend using labelled bins for sorting. Alternatively you can use opaque bags.

**Activities.** Most of the activities are either whole-class activities or small group activities. However, if you have enough materials to give each student one copy of each shape, students can do many activities individually instead. We recommend varying the structure to include individual activities, small group activities, and whole-class activities.

**Communicating reasoning in group work.** When students are working together to accomplish a task, such as sorting, tell students that they must agree on an answer, but that they should only agree on the answer if they understand their partner’s reasoning. Students must convince their partners of their choice and why it is correct. This structure can be used to assess a student’s ability to communicate their reasoning.

**Assessment.** The assessment checklist for this unit can be found in section W. The following table indicates the lessons covered by a test, which can be found in section X.

<table>
<thead>
<tr>
<th>Test</th>
<th>Lessons G1-16 to 18</th>
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**Goals**

Students will identify cubes and rectangular prisms.
Students will identify similarities and differences between real-world objects and the 3-D shape (cube or rectangular prism) they look like.

**PRIOR KNOWLEDGE REQUIRED**

Can recognize and name squares and rectangles
Can compare lengths indirectly

**MATERIALS**

large paper rectangle and square
blocks or connecting cubes
cubes, rectangular prisms, spheres, cylinders, and cones
ball, can, and party hat (or other real-world non-prisms)
real-world objects that look like cubes and rectangular prisms
modelling clay
bins
cubes of different sizes
scissors
strips of paper

**Review squares and rectangles.** Hold up a large paper rectangle and a square. Ask students to identify the shapes. ASK: Which shape has sides that are the same length? (the square) Which shape has sides that are different lengths? (the rectangle) How can you check? Invite volunteers to fold the rectangle and the square, to confirm that the top and side lengths of the rectangle are different, but the top and side lengths of the square are the same.

**Introduce cubes.** Give each student a block or connecting cube. Show students a large cube (at least 6 cm wide). SAY: This shape is called a cube. Explain that it’s not flat like a square or rectangle; it’s a 3-D shape. Explain to students that the sides of 3-D shapes are called faces. Trace a face of the cube on the board and have students do the same with their cube in their notebook (if using connecting cubes, tell them to have the linking part up—this will make tracing easier).

ASK: What is the shape of the tracing? (a square) Have volunteers compare other faces of your cube with the tracing. ASK: Are all faces of the cube the same? (yes) Have students check their cube—do all faces fit into the tracing? (yes) Encourage students who have trouble tracing a face of the cube to work with a partner and verify by direct comparison that each face of their square matches exactly with a given face of their partner’s square.
In the exercises below, use objects that you have in the classroom and display them. Students can signal thumbs up for “yes” and thumbs down for “no.” Have volunteers justify their answer. PROMPT: Are all faces squares? Have volunteers point out the faces that are not squares.

**Exercises:** Does the object look like a cube?

- a) a die
- b) a book
- c) a domino
- d) a block
- e) a connecting cube
- f) a cereal box

**Answers:** a) yes, b) no, c) no, d) yes, e) yes, f) no

**Introduce rectangular prisms.** Show students a rectangular prism. Trace a face on the board. **ASK:** What is the shape of the tracing? (a rectangle) Ask volunteers to compare other faces of the prism with the tracing (only one other face will fit). Repeat for a book. **SAY:** These shapes are called rectangular prisms. **ASK:** How is a rectangular prism more like a rectangle than a square? (some faces are different and in a rectangle some sides are different) **SAY:** In a prism, the faces go straight up and down. Show students a sphere and **ASK:** Is this a prism? (no) How do you know? (the face curves; the shape gets wider then narrower) Repeat for a cone on its flat side. (no, the shape gets narrower as you go up or wider as you go down) Show students a cylinder. **SAY:** These faces do go straight up and down, but the bottom is not a rectangle. Show students the bottom face and have students predict the shape. Trace the circular face on the board and **ASK:** What shape is the tracing? (a circle) **SAY:** This shape is not a rectangular prism.

In the exercises below, use objects that you have in the classroom and display them. Use the same non-cube rectangular prisms as you did in the previous exercises.

**Exercises:** Does the object look like a rectangular prism? If not, explain why not.

- a) a ball
- b) a book
- c) a domino
- d) a can
- e) a party hat
- f) a cereal box

**Answers:** a) no, because the sides do not go straight up and down; b) yes; c) yes; d) no, because the bottom is not a rectangle; e) no, because the sides do not go straight up and down; f) yes

**Cubes and rectangular prisms in the environment.** Show students a cube and a block. Discuss similarities (sample answers: they are both wood, they look like cubes) and differences (sample answers: one is bigger, one has letters on it). Repeat for a die, again comparing to the cube (similarities: they look like cubes; differences: the die has rounded corners, is made of plastic, and has indents for the dots), and for connecting cubes (they look like cubes, but have a linking part that sticks out, are made of plastic).
For the following exercises, show students a rectangular prism. Use real-world objects that you have available in the classroom.

Exercises: Take turns with a partner saying things that are the same or different about each object and the example rectangular prism.

a) a softcover book    b) a box    c) a desk drawer

d) a bookshelf  e) a stack of paper  f) dominoes

Selected sample answers: a) the book is thinner and wider, they both look like rectangular prisms, they both have rectangles on every side, made of paper instead of wood; c) the desk drawer might have rounded corners, is bigger, might not have a front side, the sides might not be straight up and down

ACTIVITIES 1–2 (Essential), ACTIVITIES 3–4 (Optional)

Activities 1–4 can be done at stations if you do not have enough materials for students to work simultaneously in small groups.

1. Have students sort rectangular prisms (at least three cubes and three non-cubes) using the group “cubes.” Use a bin labelled “cubes.” Encourage students to trace the sides of the shapes onto paper to distinguish between the cubes and the non-cubes. Alternatively, students could imprint their prisms into modelling clay. Then, when students finish, ask them to put away their shapes into the correct classroom bin. Emphasize how sorting helped them to clean up quickly and keep the classroom organized.

Bonus: Include other shapes, such as cylinders, spheres, and cones, and sort into groups labelled “cubes,” “rectangular prisms (not cubes),” and “other.”

2. Have students create cubes and other rectangular prisms from modelling clay. Encourage them to flatten the sides because cubes and prisms have flat sides. If students struggle, suggest that they put one face on the flat desk and press a flat object (such as a block) against the top face to make the top and bottom faces both flat. Then repeat with the other faces.

3. Give small groups of students strips of paper and cubes of different sizes such as a connecting cube, an alphabet block, and a square tissue box. Have students cut strips of paper the same length as the cubes from side to side, and then compare the strip of paper to the length of the cube from front to back, and from top to bottom (demonstrate on your large cube). ASK: What do you notice? (the three lengths for each cube are all the same)
4. Play “I Spy” using cubes or rectangular prisms in the description. EXAMPLES: a rectangular prism that is black (a computer), a cube with black dots on each side (a die), a cube with a letter on each side (a block), a thin rectangular prism on top of my desk (a JUMP Math AP Book).

NOTE: If students struggle with finding or drawing objects that look like cubes or other rectangular prisms when doing AP Book 1.2 pp 141–142, they can look through magazines or catalogues to find such shapes and then cut them out and glue or tape the pictures in their AP Book or notebook.

Extensions
1. a) Stack two pattern block squares one on top of the other. Is your shape a cube or a rectangular prism?

b) Stack three pattern block squares one on top of the other. Is your shape a cube or a rectangular prism?

c) If you keep stacking pattern blocks one on top of the other, can you make a cube? How do you know?

Sample answers: a) a rectangular prism, b) a rectangular prism, c) no, because stacking three of them is already taller than it is wide, so making it taller will not help

2. Make a tile floor using four pattern block squares, as shown below, and keep stacking until you make a cube. How many levels do you need?

Sample answer: 5

3. Show students a square prism that is not a cube. Have students trace around the shape to determine the shapes that the tracing can make. ASK: How many squares are there? (2) What shape are the other sides? (rectangles) How many of the non-square sides are the same? (all of them)

4. Give students a triangular prism and a rectangular prism.

a) What is the same about the two shapes?

b) What is different about the two shapes?

Sample answers: Students might notice characteristics such as colour, size, material, sharp corners, top and bottom are the same on each shape but different from each other (triangles on one and rectangles on the other), the sides go straight up and down in both shapes.

JOURNAL
A cube is like a square because ________.
A rectangular prism is like a rectangle because ________.
Goals

Students will identify spheres, cylinders, and cones.
Students will identify similarities and differences between real-world objects and the 3-D shape (sphere, cylinder, or cone) they look like.

Prior Knowledge Required

Can recognize and name circles, squares, and rectangles

Materials

spheres, cylinders, and cones
egg-shaped object
2 spheres or balls of different sizes and colours
real-world objects that look like spheres, cylinders, and cones
modelling clay

Introduce spheres. Show students a sphere and SAY: This shape is called a sphere. It is perfectly round and curves the same everywhere. Demonstrate by curving your hand around the shape to show how you don’t have to change how your hand bends. Show students an egg-shaped object and SAY: This is not a sphere. Demonstrate by curving your hand around the shape how it curves a lot around the ends and only a little around the middle.

Show students a cylinder and ASK: Is this a sphere? (no) Cover the curved surface with the curve of your hand and SAY: This part is curved. Cover one of the circles with a straight hand and SAY: This part is flat—it doesn’t curve at all. This shape is not a sphere because a sphere curves everywhere. Show students a cone and ASK: Is this a sphere? (no) How do you know? (it has a flat part and a curved part, but a sphere curves everywhere) Repeat for a cube and a rectangular prism. (their faces are flat, so they are not spheres)

Show students two spheres or balls of different sizes and different colours and ASK: Which sphere is bigger? SAY: Spheres can be big or small and they can be different colours, but they are spheres if they are perfectly round all over and curve the same everywhere. Name or show the shapes for the following exercises and have students signal thumbs up for “yes” and thumbs down for “no.”

Exercises: Does the object look like a sphere?

a) a tennis ball  
b) a box

c) a soup can  
d) a ping pong ball

e) a waffle cone  
f) an orange

g) a snowball  
h) a party hat

Geography 1-16
Answers: a) yes, b) no, c) no, d) yes, e) no, f) yes, g) yes, h) no

**Introduce cylinders and cones.** Show students a cylinder and SAY: This is called a cylinder. Show students one circular end of the cylinder, trace your hand around the circle and ASK: What shape is this? (a circle) Trace the circular end on the board. ASK: What shape is the tracing? (a circle) Show students the other end and ASK: What shape is this? (a circle) Demonstrate that it fits exactly into the tracing. SAY: A cylinder has a circle at both ends and the two circles are the same size. They can be the top and bottom (show a cylinder on one of its circular sides), or they can be the sides (show a cylinder lying on its curved side), or anything in between (show a tilted cylinder).

Show students a cone and ASK: Is this a cylinder? (no) How do you know? (it doesn’t have a circle at both ends) SAY: This shape has a circle at one end. Point out the circle and trace it on the board. SAY: It has a point at the other end (point out the cone’s point). This shape is called a cone. A cone has a circle at one end and then it gets thinner and thinner until it’s just a point.

Display a cylinder, a cone, and a sphere. Point to the shapes in a random order and ASK: Is this a cylinder? Is this a sphere? Is this a cone? Have students signal thumbs up for “yes” and thumbs down for “no.” Have volunteers explain how they know. (sample answer: it is a cone because it has a circle at one end, and a point at the other) If students answer no by naming a shape as their reasoning, ask them how the two shapes are different. (a sphere does not have a flat circle on it)

Point to the sphere and ASK: Is this a circle? (no) How do you know? (it is not flat) Point to the cone and ASK: Is this a triangle? (no) How do you know? (it is not flat)

**Spheres, cylinders, and cones in the environment.** Display a sphere, a cylinder, and a cone. Show students a party hat with the point up. ASK: Has anyone been to a birthday party where they had party hats? Which shape does a party hat look like: a sphere, a cylinder, or a cone? (a cone) Why do you say that? (it has a circle on the bottom and a point on top) Hold up a solid cone with the point down and ASK: How is the party hat different from this cone? (it’s bigger, it’s not solid, it is made of paper, it has a string on the bottom and strings hanging off the top, it has a picture on it, it’s pointing up) Can I put my hand inside the cone of a party hat? (yes) Demonstrate doing so. ASK: How about this cone (hold up the solid cone)? (no) SAY: Remember that closed means that you cannot get inside the shape from outside, and open means you can. ASK: Which cone is closed, the party hat or the solid cone? (the solid cone) SAY: That’s another difference between them.

Distribute sets of 3-D shapes. Name each object in Exercise 1 below and have students hold up the matching shape. Alternatively, you can write the words on the board in different locations and students can point to the
correct word. To signal whether the shape is open or closed, students can make an “o” with their hand for “open” and “c” for “closed.”

**Exercises**

1. Does the object look like a sphere, a cylinder, or a cone? Is it open or closed?
   
   a) a hockey puck  
   b) a party hat  
   c) a soup can  
   d) a ping pong ball  
   e) a paper towel roll  
   f) a snowball  
   g) a new pencil  
   h) a waffle cone  
   i) a globe  
   j) a straw  

   **Answers:** a) cylinder, closed; b) cone, open; c) cylinder, closed; d) sphere, closed; e) cylinder, open; f) sphere, closed; g) cylinder, closed; h) cone, open; i) sphere, closed; j) cylinder, open

2. Take turns with a partner saying differences between the object and the solid 3-D shape it looks like.

   a) a soup can  
   b) a water bottle  
   c) a pylon  
   d) a ping pong ball  
   e) a straw  
   f) a globe  
   g) a waffle cone  

   **Sample answers**
   a) a cylinder: the circles are indented a bit, there is a picture on it, it is heavier, it is made of metal
   b) a cylinder: it gets thinner at the top, there is an indent at the bottom, there is writing on it, there are ridges, it is made of plastic
   c) a cone: there is no point on top, there is a small circle on top, there is a square base around the circle at the bottom, it is open, it is made of plastic
   d) a sphere: it is lighter, it is white, it is smaller, it is made of plastic
   e) a cylinder: it is open, there is a pattern on it, it is long and thin, it is made of plastic
   f) a sphere: there is a base at the bottom, there is a picture on it
   g) a cone: the circle at the top might not be a real circle but more like an oval, there might be a hole in the bottom of the cone, the cone is open, it has a pattern on it, you can eat it
ACTIVITIES 1–2 (Essential), ACTIVITIES 3–4 (Optional)

1. Demonstrate to students how to make spheres, cylinders, and cones from modelling clay and then have them do so themselves. For example, to make a cone, place a ball of clay on your desk and roll your tilted flat hand back and forth, then flatten the wide end.

2. Have students press the flat sides of their 3-D shapes into modelling clay. ASK: What shape does the side make? (a circle) Students can also trace the flat sides of their shapes and check that the tracing is a circle. Have students sort the shapes they used into the correct classroom bins. Emphasize how sorting the shapes into the bins keeps the classroom organized.

3. Have students work in small groups to try to make towers out of the clay shapes they made. ASK: Can you put one sphere on top of another sphere? One cylinder on top of another cylinder? One cone on top of another cone? Which shape is best for making towers, spheres, cylinders, or cones? (cylinders)

4. Play “I Spy” using geometric and measurement terminology. Use all the shape names learned so far. EXAMPLE: I spy with my little eye, a long thin cylinder (e.g., a straw or new pencil).

NOTE: If students struggle with finding or drawing objects that look like spheres, cylinders, or cones when doing AP Book 1.2 pp 143–145, they can look through magazines or catalogues to find such shapes and then cut them out and glue or tape the pictures in their AP Book or notebook.

Extensions

1. SAY: Snowmen are made from spheres stacked one on top of the other. ASK: How is that possible? (the snow ball changes its shape when stacked; it gets flattened at the top and at the bottom) You might demonstrate with modelling clay.

2. Show students a bowl.
   a) How would you have to change the bowl to make it a cylinder?
   b) How would you have to change the bowl to make it a sphere?
   **Answers:** a) make the sides go straight up and down; b) put another bowl on top upside down, then round out the tops and bottoms

3. Challenge students to think of fruits and vegetables and decide whether they can describe them as being like one of the shapes studied so far (i.e., cubes, prisms, spheres, cylinders, cones).
   **Sample answers:** carrots are sometimes more like cylinders and sometimes more like cones, cucumbers are like cylinders but the ends are not flat, pineapples are like cylinders but a little wider in the middle, many fruits are like spheres

**Connection**

Real World
4. Does the shape have symmetry? What parts match: left and right, front and back, or top and bottom?

   a) a cube  
   b) a rectangular prism  
   c) a sphere  
   d) a cylinder  
   e) a cone

   **Answers:** a) all, b) all, c) all, d) all, e) left and right and front and back

5. Find objects in the environment that have the type of symmetry. Count how many of each type you find.

   a) The left and right sides look the same.  
   b) The top and bottom look the same.  
   c) The front and back look the same.

   **ASK:** What is the most common type of symmetry?

   **NOTE:** Students can look around the room, outside, or through magazines and catalogues. When students look at objects that have a definite front, they should look from the front to determine the left and right sides. For example, a car looks the same on the left and right sides when looking from the front, but not from the side. From the side, they are really comparing the front and back of the car.
Goals

Students will identify and count faces of 3-D shapes.
Students will distinguish between flat and curved faces, and between faces that roll and slide.

PRIOR KNOWLEDGE REQUIRED

Can identify cubes, other rectangular prisms, spheres, cylinders, and cones
Can sort 3-D shapes using a single attribute
Can use strategies to keep track of counting objects

MATERIALS

cubes, rectangular prisms, spheres, cylinders, and cones
bins
ramp
egg-shaped objects, triangular prisms, and pyramids

NOTE: You will need a ramp (e.g., made from one or two empty binders) in this lesson. Make sure the ramp is steep enough that shapes with flat sides will slide, but not so steep that they will topple.

Counting faces of 3-D shapes. Remind students that the sides of 3-D shapes are called faces. You might say that a face is any part of the shape where you can draw a human face. To draw a face you need room to draw eyes, a nose, and a mouth, so any part of the shape that provides even a small amount of room for you to do so is a face. Show the faces on the cube, then hold up a cone. ASK: Where can we draw a face on a cone? Have a volunteer demonstrate. ASK: How many faces does a cone have? (2) Repeat for a cylinder (3) and a sphere (1).

For the following exercises, give each group of two or three students a cube or other rectangular prism. Use the group work structure to encourage students to communicate their reasoning (see unit introduction).

Exercises: Determine how many faces your shape has.

Answer: 6

When students finish, allow volunteers to explain how they counted the faces. Some strategies include:

• I counted the faces that go up and down, there are four of them, and then I counted the top and bottom faces. (write this on the board as $4 + 2 = 6$)

• I counted the two top and bottom faces, the two left and right faces, and the two front and back faces. (write this on the board as $2 + 2 + 2 = 6$)
• I counted the top face first, then I started at the front and went around, and then I counted the bottom face.

**Curved and flat faces.** Explain that faces can be curved or flat. Show various shapes and check the faces one by one, demonstrating with the curve or flatness of your hand. ASK: Is this face flat or curved?

Give each group of five students one of each 3-D shape (cube, rectangular prism, sphere, cylinder, and cone). Tell students that they must put their shape where it belongs, either in the group or outside the group. Use the group work structure to encourage students to communicate their reasoning (see unit introduction).

**Exercises:** Sort the shapes into the group “has curved faces.”

**Answers:** cones, spheres, and cylinders have curved faces; cubes and rectangular prisms do not

**Roll and slide.** Write “rolls” and “slides” on the board. Read the words aloud or have a volunteer do so. Explain what each word means.

Show students a ramp. ASK: Who has a shape that rolls? Have different volunteers show how their shape rolls down the ramp. ASK: Which shapes roll? (a sphere, a cylinder on its side, and a cone on its side) Who has a shape that will slide down the ramp? Have different volunteers show how their shape slides down the ramp. ASK: Which shapes slide? (cone on its circle, a cylinder on one of its circles, rectangular prism or cube on any side) Which faces roll, the flat faces or the curved faces? (the curved faces) Which faces slide, the flat faces or the curved faces? (the flat faces) Have volunteers demonstrate this with their shape.

For the exercises below, each student, or group of five students, will need one of each 3-D shape. Provide other shapes as well, such as egg-shaped objects, triangular prisms, or pyramids. If working in groups, students take turns placing objects in each group and then communicate their reasoning (see unit introduction).

**Exercises:** Sort the shapes into the group.

a) can slide

b) can roll

c) can slide and roll

**Answers:** a) cubes, rectangular prisms, cylinders, cones; b) spheres, cones, cylinders; c) cones and cylinders
ACTIVITY (Essential)

Be sure that each student gets a turn at both stations.

**Station A.** Provide one of each of the five basic shapes, and other shapes such as triangular prisms, rectangular pyramids, or egg-shaped objects. Students line up to be sorters and guessers. Sorters decide on a secret sorting rule and sort the shapes into the secret group. Guessers guess the sorting rule until they guess correctly (sorters can give hints if necessary). The sorter then goes to the back of the guesser line and the guesser goes to the back of the sorter line. Be sure that everyone gets a turn at each role. Encourage students to make up a new rule that other students haven’t used yet for sorting.

**Station B.** Have at least one each of the five basic shapes for every five students working at this station. Tell students you are going to let them play with the 3-D shapes, but you want them to pretend each shape is a real-world thing of that shape.

When students finish using the 3-D shapes, encourage students to sort the shapes back in their correct classroom bins.

**Extensions**

1. **Teach edges of 3-D shapes.** Give each student a cube. SAY: An edge is a line where two faces meet. Demonstrate with a cube, tracing your finger along the edge where the two faces meet. Have students find an edge of their cube and trace along it with their fingers. ASK: Which two faces meet at the edge? (have volunteers demonstrate) Is the edge straight or curved? (straight) Show students a cone and demonstrate how the curved face meets the flat face in a curved line. Trace along the edge and SAY: This curved line is also an edge. Show students a sphere. ASK: How many faces does a sphere have? (1) SAY: A sphere does not have two faces meeting, so there is no edge. Have students sort a set of five shapes into the group “shapes with curved edges.” (cones and cylinders are in the group)

2. How many edges does a cube have? Hint: Count separately three types of edges: the edges that are on the table, the edges that go straight up and down and touch the table, and the edges on the top that don’t touch the table.

   **Answer:** 12, there are 4 of each type: \(4 + 4 + 4 = 12\)

   **Bonus:** Count the edges of a pentagonal or hexagonal prism.

   **Answers:** 15 or 18
3. Sort a set of 3-D objects or the pictures from BLM 3-D Objects (p S-63) into the group “closed.”

**NOTE:** Students will use the pictures from BLM 3-D Objects in the next lesson.

4. Pairs will need modelling clay, a cone, a sphere, a cylinder, a cube, and a rectangular prism. Use cones and cylinders that have different sized circles.

Partner A: Close your eyes.

Partner B: Make a mould in the modelling clay and remove the shape.

Partner A: Find the shape that your partner used to make the mould.

Then switch roles.

Encourage students to place the shape in the mould in various directions.
Goals

Students will recognize 3-D shapes from pictures, descriptions, and from feel.
Students will sort 3-D shapes, or pictures of 3-D shapes, by various attributes.

PRIOR KNOWLEDGE REQUIRED
Can identify cubes, rectangular prisms, spheres, cylinders, and cones
Can explain why a shape is or is not a cube, rectangular prism, sphere, cylinder, or cone
Can sort objects using one attribute
Can count

MATERIALS
- cubes, rectangular prisms, spheres, cylinders, and cones
- BLM 3-D Objects (p S-63)
- BLM Sorting Circle (p S-55)
- BLM 3-D Shapes (p S-64)
- connecting cubes
- opaque bags
- catalogues, magazines, or newspapers
- glue or tape

Identifying individual shapes from pictures.

ACTIVITY 1 (Essential)

1. Students should do at least one of the stations. Station A is simpler.

   Students will need one of each 3-D shape and the cards from BLM 3-D Objects. As students work, encourage them to explain their choices. (Examples: I know this is a cone because there is a circle and a point; I know this is a cube because all the sides are squares.)

   Station A. Use the 3-D shapes to label the sorting areas. First have students sort the cards with cubes and rectangular prisms into two groups: cubes and other rectangular prisms. Then have them sort the remaining shapes into three groups: spheres, cylinders, and cones. Students can use the actual shapes—pick them up and view them from different angles—to identify the shapes on the cards. Have students who finish early repeat, this time using a different sorting rule of their choice.
Station B. Have students play Memory in pairs. Start with the cards for only two different shapes. Place the cards in a 2 by 4 array. Players take turns turning over two cards. If the cards match, they are placed in the discard pile; if they do not match, they are turned face down again. Two cards match if they show the same shape. The goal is to place all the cards in the discard pile. If students have any non-matching cards left at the end, then some of their cards must have been matched incorrectly.

Play again, using only the remaining cards in a 3 by 4 array. Students can use the actual shapes—pick them up and view them from different angles—to identify the shapes on the cards.

Bonus: Use all five shapes at once and play with all 20 cards.

Identifying shapes of flat faces in pictures. Give each student either a cube, a non-cube rectangular prism, a sphere, a cone, or a cylinder.

ASK: Who has a shape with a flat face? Have different volunteers show a flat face of their shape. ASK: What flat shape is it? (allow many volunteers to answer: cylinders and cones have circles, cubes have squares, and rectangular prisms have rectangles) Who has a shape without any flat faces? Which shape does not have any flat faces? (a sphere) Draw on the board:

ASK: What shape is this a picture of? (a cylinder) ASK: Did I colour the flat face or the curved face? (the flat face) What shape is the face that I coloured? (a circle) PROMPT: Show students a concrete cylinder and place the cylinder in the same position as the picture. SAY: This coloured shape does not look like a circle in the picture (show how it curves more at the top than at the sides), but if you look at the real object, you can see that it is a circle. It is just the way it is drawn that makes it not look like a circle.

Give students solid shapes to compare to the drawings in the exercises below. Small groups of students can share the shapes if necessary, but students should do the exercises individually.

Exercises: What shape is the shaded face?

a)  b)  c)  d)  e)  f)

Answers: a) circle, b) square, c) circle, d) square, e) rectangle, f) square

If students have trouble recognizing the shape of the flat faces, even from the concrete shape, have students place the flat side of their concrete shape on a sheet of paper and trace around it. ASK: What shape is the tracing? If students have trouble tracing around the shape, have them place a sheet of paper over the shape and fold down the paper. ASK: What is
the shape of the fold lines? Alternatively, students can press the shape into modelling clay and look at the mould.

For the exercises below, give small groups of students BLM Sorting Circle and cards from BLM 3-D Shapes. **NOTE:** Students will need the cards again in Activity 2.

**Exercises:** Sort the shapes into the group.

a) has a face that is a square  
b) has a face that is a non-square rectangle  
c) has a face that is a circle

**Answers:** a) the 3 cubes, b) the 5 rectangular prisms, c) the 5 cones and 4 cylinders

**Identifying shapes that stack.** SAY: We are going to build towers. Show students two cylinders. ASK: Will the tower stay up if we put one cylinder on top of another? (yes) Have a volunteer do so. Repeat for cones (no), cubes (yes), rectangular prisms (yes), and spheres (no).

If you do not have enough shapes for each group of five or six students, do the Activity 2 as a demonstration instead.

**ACTIVITY 2 (Essential)**

2. Each group of five or six students will need the pictures from BLM 3-D Shapes, shuffled, face down in a pile and three to five of each solid 3-D shape (one per card). Have students take turns turning over the top card of the pile and stacking the 3-D shapes chosen, one on top of the other, to create towers. When the tower cannot be continued, a new tower starts. As students work, ASK: What shapes are at the tops of the towers? Which shapes can go anywhere in the towers? Which shapes can be placed any way and which shapes must be placed in a specific way? When students finish, take up those questions with the class. (the spheres and cones are at the top because you cannot stack anything on top of them; cylinders have to be standing on an end to place something on top of them)

**Introduce corners of 3-D shapes.** Give each student a cube, such as a connecting cube. SAY: In mathematics, corners are sharp points. If a corner is rounded, it is not really a corner in math. Have students find the corners on their cube. Hold up a cylinder, trace your fingers around one of the circles, and SAY: This shape has no sharp points. Hold up a cone and ASK: Does this shape have any corners? (yes) Have a volunteer point it out. Repeat for a rectangular prism (yes, it has many) and a sphere (no).

**Identifying 3-D objects by feel.** Display a cube, a sphere, a cylinder, and a cone. Give each student one such 3-D shape in an opaque bag. Tell students that their shape is one of these, but do not tell them what their shape is. Have students reach in and feel their shape. ASK: Who has a
shape with pointy corners? How many corners do you feel? Does your shape have any sides that are flat? How many flat sides does it have? What shape are the flat sides? Are there any curved sides? How many? Have volunteers guess what shape is in their bag and justify their prediction, then bring out their shape to check. Then have students switch bags with another student and play again. This time, volunteers can describe their shape without the prompting. Have students switch bags again and then do the following exercises in pairs.

**Exercises**

Partner A: Describe your shape by feel to your partner.

Partner B: Guess your partner’s shape.

Partner A: Reveal your shape.

Then switch roles.

### ACTIVITIES 3–4 (Optional)

3. Give each small group a different 3-D shape: cubes, rectangular prisms, spheres, cylinders, or cones. Ask each group to make collages or posters for their shape. They can look for examples of their shape in old catalogues, magazines, and newspapers. They can also think of examples in everyday objects and add drawings to their collages or posters.

4. **Guessing shapes from clues.** Display the basic 3-D shapes. Ask students to guess which shape you are thinking of. Give clues one at a time and remove shapes from the collection accordingly. Start with the cylinder, and SAY: My shape can slide. ASK: Which shape cannot slide? (a sphere) Why can we remove the sphere from the collection? (a sphere does not slide and your shape does; your shape cannot be a sphere) Continue with: my shape can roll (remove the cube and rectangular prism) and my shape has two flat sides (remove the cone), until only the cylinder is left. Repeat with a cone (my shape has a flat part, my shape has a curved part, my shape has a corner), a cube (my shape stacks well, all the sides are squares), a rectangular prism (my shape can slide, my shape has no curved side, it is taller than it is wide), and a sphere (my shape can roll, my shape has no corners, it cannot slide).

**NOTE:** If students struggle with identifying the shape of the shaded face on the AP Book 1.2 p 148, provide them with the concrete 3-D shapes to place on their desk in the orientation drawn and encourage them to find the shaded face.
Extensions

1. How many corners does the shape have? Explain to a partner how you found your answer.
   a) a cone   b) a sphere   c) a cylinder   d) a cube

Selected solution: d) I placed the cube on the table and there are 4 corners on the top and 4 corners on the bottom, so 8 altogether

Answers: a) 1, b) 0, c) 0

NOTE: Students will need to know that an edge is the line where two faces meet to do Extensions 2–4. (See Extension 1 in Lesson G1-17 to introduce edges.)

2. Write on the board:
   slide  roll  square  circle  rectangle

Provide students with BLM Describing Shapes (p S-65). Tell students to write numbers in the boxes and words in the blanks. If students are engaged, have them write and illustrate similar descriptions of a sphere and a rectangular prism.

Answers: 6, 0, slide, roll, squares; 1, 1, circle, slide, roll, 1, 1; 2, 1, circles, slide, roll, 0, 2

3. What shape am I?
   a) I am a cone, a cube, or a cylinder. I have a curved face. I have no corners.
   b) I am a cylinder, a cube, or other rectangular prism. I have straight edges. I have 6 matching faces.
   c) I am a cylinder, a rectangular prism, or a sphere. I have 1 curved face. I have no edges.
   d) I am a cylinder, sphere, cone, cube, or other rectangular prism. I have no corners. I have no edges.

Answers: a) cylinder, b) cube, c) sphere, d) sphere

4. Give students a cube, a rectangular prism, and a cone.
   a) How many edges touch each corner of the cube?
   b) How many faces touch each corner of the cube?
   c) How many edges touch each corner of the rectangular prism?
   d) How many faces touch each corner of the rectangular prism?
   e) How many edges touch the corner of the cone?
   f) How many faces touch the corner of the cone?

Answers: a) 3, b) 3, c) 3, d) 3, e) 0, f) 1
5. Discuss with a partner.
   a) How are cylinders like circles?
   b) How are cylinders different from circles?
   c) How are cylinders like rectangles?
   d) How are cylinders different from rectangles?

**Bonus:** Is a cylinder more like a circle or a rectangle?

**Sample answers:**
a) cylinders have circles on them; both shapes do not have corners; b) cylinders are thicker, they are not flat, they can be tall and thin or short and wide; c) when standing on an end, cylinders are the same width from top to bottom, just like rectangles; both shapes can be tall and thin or short and wide; d) cylinders are not flat, they have circles on them, they do not have any corners, they have a curved part; they have curved edges, while rectangles only have straight sides; Bonus: answers may vary

6. Give each pair of students a cone and a square pyramid. Partners can take turns saying what is the same about the shapes and what is different about them.

**Sample answers:** they both have a corner; one has a circle and the other has a square; they both get thinner and thinner; the cone has one curved edge and the other shape has straight edges; the cone has only one corner and the other shape has many corners

7. Discuss with a partner.
   a) How are cones like circles?
   b) How are cones different from circles?
   c) How are cones like triangles?
   d) How are cones different from triangles?

**Bonus:** Are cones more like triangles or circles?

**Sample answers**
a) cones have a circle on them
b) cones are thicker, they are not flat; cones can be tall and thin or short and wide; cones have a corner
c) when standing on the circle, cones get thinner and thinner, just like triangles standing on one side; cones can be tall and thin or short and wide, like triangles; cones have a corner
d) cones are not flat; cones have a circle on them; cones have only one corner, while triangles have three corners; cones have a curved edge, but triangles have only straight sides; Bonus: answers may vary
8. Students will need open and closed cones, at least two identical ones of each. You can make the closed cones from BLM Nets for Cones (p S-49) and the open cones from BLM Net for Open Cones (p S-66). To ensure that the open cones are identical, you might draw a line to show how much overlap you will use and use the same line for each cone. Have students stack the open cones and then stack the closed cones. ASK: What stacks better, open cones or closed cones? Would open cones be useful for making tall towers? Explain.

**Answers:** the open cones stack better because at least they fit on top of each other and will stay, but they are not useful for making tall towers because even though they can stack, they will not make the tower much taller.

9. Give students a die that has rounded corners and ask if there are any pointy corners on the die. (no) Explain that the die looks like a cube and is almost a cube, but it is not actually a cube because cubes have sharp corners.
G1-19 Composing 3-D Shapes
Pages 151–153

CURRICULUM REQUIREMENT
AB: required
BC: required
MB: required
ON: required

VOCABULARY
cone
cube
curved
cylinder
rectangular prism
sphere

Goals
Students will compose and decompose 3-D Shapes.

PRIOR KNOWLEDGE REQUIRED
Can identify cubes, other rectangular prisms, spheres, cylinders, and cones
Can identify the shapes of flat faces of 3-D shapes

MATERIALS
real-world objects that consist of composite shapes
2 large, 5 medium, and 2 small cubes
2 large, 2 medium, and 4 small cylinders
2 large, 2 medium, and 2 small cones
2 large, 2 medium, and 2 small rectangular prisms
6 spheres or balls of different sizes and colours
BLM Sorting Circle (p S-55)
BLM Possible or Not Possible (p S-67)

NOTE: See unit introduction (p S-2) for information about the specific 3-D shapes required for this lesson.

Identifying shapes in composite real-world objects. Tell students that lots of things in the real world appear to consist of more than one 3-D shape.
ASK: Which 3-D shape would you use to show a person’s head? (a sphere) What about a person’s arms? (a cylinder) Which part of your desk looks like a prism? (the top part; the drawer) Which part looks like cylinders? (the legs) Provide several real-world objects that appear to consist of different 3-D solids, such as: bottles, connecting cubes (with the linking part sticking out), round sharpened pencils, crayons, or toys. Have students trace lines, using their fingers, on the objects where the geometric shapes change.

Play “I Spy” using objects that are composed of more than one 3-D shape. Examples: your desk is a large wooden thin rectangular prism with four tall narrow wooden cylinders; a blue crayon is a blue cylinder with a blue cone on top; a toy bus is a yellow plastic rectangular prism with two square ends, and four cylinders on the bottom, the cylinders are standing on a curved side and they are as wide as they are tall.

Building 3-D structures. Show students four small cylinders and a large rectangular prism. Tell students that you would like to make a table. Allow time for students to think about how to do so, then discuss with a partner what role each shape should play. (the cylinders will be the legs and the prism will be the top) Then have a volunteer make the table.

Show students a crayon that has a clearly visible cylinder and cone.
ASK: What two shapes make this crayon? (a cylinder and a cone) Which
part is the cone, the part that writes on the paper, or the part that you hold? (the part that writes on the paper) Bring out a solid cylinder and three solid cones (the circles on the cones should be three different sizes, one fitting the cylinder, one too big, and one too small). Demonstrate putting the too big circle on the cone and SAY: Does this look like my crayon? (no) Why do you say that? (the circle sticks out) PROMPT: Do crayons have the cone sticking out, bigger than the cylinder? (no) Repeat for the too small cone (no, the cone doesn’t fit; the cylinder part sticks out) and the cone that fits (yes, because the cone fits) SAY: For the cylinder and cone to make a good crayon, the circles should be the same size.

Build and display the structures for the exercises below, and label them. Then display the shapes not used for students to choose from in parts g) and h).

Exercises

a) What shapes are used to make the train?
b) What shapes are used to make the tower?
c) What shapes are used to make the lamp?
d) What part of the lamp is the cone?
e) Which structure has different-sized squares?
f) Describe the circles in the cylinders and cone in the lamp. How do they compare?
g) What shape would you use to make a longer train?
h) What shape would you use to make a taller lamp?

Answers: a) 3 cubes and a cylinder, b) 3 cubes, c) 2 cylinders and a cone, d) the lampshade, e) the tower, f) the cone’s circle is bigger than the circles in the cylinders; the circles in the cylinders are the same size, g) a cube the same size as the other three, h) a cylinder the same size as the other two

After students finish the exercises, have volunteers demonstrate how to make the train longer (use a cube the same size as the other three) and the lamp taller (use a cylinder with a circle the same size as the other two). Emphasize that if they had a longer cylinder with the same size circle or a longer rectangular prism with the same size square, that would also work.
ACTIVITY (Essential)

Place two or more of each 3-D shape at each station. At Stations B and C, use different-sized copies of each shape, if available. Be sure that each student gets a turn at each station.

Station A. Player 1 builds a structure from one set of 3-D shapes. Player 2 identifies the shapes used to build the structure and selects them from the other set. Player 2 checks the solution by deconstructing the structure and pairing up the chosen shapes with the shapes from the structure. Then the two players switch roles.

Variation: Players check their solutions by building a replica instead of deconstructing the original structure.

If you want to allow more than two students at a time to participate at this station, you could have students form two lines, one to be the builder and the other to be the copier. Students at the front of each line go to the back of the other line. Be sure that everyone gets a turn at each role.

Station B. Remind students it is not possible to build some structures by stacking shapes on top of one another. Show a cone standing on its point with a cube on top. ASK: Will this structure stay up if I let go? (no) Let go to verify that the structure topples. Give students a copy of BLM Sorting Circle with the circle labelled “Possible” and the cards from BLM Possible or Not Possible. Have students sort the pictures based on whether or not they are possible to build (without gluing the pieces together). Then have students check their answers by building the ones they said are possible.

Station C. Have students make a tower from two shapes chosen from cubes, prisms, and cylinders, putting smaller shapes on top of larger shapes, so that the shapes on top fit completely on the shapes below it. From above, have students trace the faces in their structure on a sheet of paper. Trace the bottom shape first, then, inside their tracing, trace the top shape. Students then work with a partner. Student 1 hides the structure and gives the drawing to Student 2. Student 2 re-constructs the structure. Students check if their partner built it correctly. NOTE: Students can work on their partner’s structure simultaneously. Example:

NOTE: If students struggle with deciding which shape is not in the tower on AP Book 1.2 p 153, encourage them to circle the names of the shapes they used in the grey box. Then, they just need to look at which shape name is not circled.
Extensions

1. Have students build a city with a small number of blocks. Have them count how many of each shape they used. Give each shape a monetary value (e.g., cones are five cents). How much will the city cost to build?

2. Ask students to choose several shapes that stack well to build a tower. Tell them that they can use a cone for the top of their tower if they want, but they cannot use a cone anywhere else. Once all students have chosen their shapes, ask them to predict how tall their towers will be compared to other objects in the classroom. Let them build their towers and check their predictions using indirect measurement (e.g., by creating a piece of yarn the same length as their tower is tall and comparing it to the other objects in the classroom).

3. Students work in groups of four. Player 1 makes a design using two or three shapes that stack well. The other players copy the design. The group puts their designs together to make a bigger design. For example, students can make a tower from a cube, a cylinder, and a cone, and combine them into a castle of four towers. Repeat the exercise with different groups of shapes, so that each student in the group invents a design. If time allows, repeat with designs made of more shapes.

4. Challenge students to make a structure with spheres on the bottom.

Sample answer

![Sample answer image]
Nets for Cubes (I)
Nets for Cubes (2)
Nets for Cubes (3)
Nets for Prisms (I)
Nets for Prisms (2)
Nets for Cylinders (I)
Nets for Cylinders (2)
Nets for Cones
Location Picture Cards

[Images of various geometric shapes and their arrangements]

S-52 Blackline Master — Geometry — Teacher’s Guide for Grade 1
Sorting Circle
3-D Objects

ABC

DICE

WASHING MACHINE

CUBE

BASKETBALL

GLOBE

CHRISTMAS BALL

BASEBALL

MUG

POP CAN

SOUP CAN

STRAW

FISH TANK

CEREAL BOX

FRIDGE

TISSUE BOX

PARTY HAT

ICE CREAM CONE

PYRAMID
3-D Shapes
Describing Shapes

**Cylinder**
- A cylinder has __________ corners and __________ curved edges.
- A cylinder can __________.
- The flat faces are __________ and __________.

**Cone**
- A cone has __________ face and __________ face.
- A cone can __________.
- The flat face is __________.
- A cone can __________ and __________.
- A cone has __________ corner and __________ curved edge.

**Cube**
- A cube has __________ faces and __________ curved faces.
- A cube can __________.
- The flat faces are __________.
- A cube can __________.
- It cannot __________.
Net for Open Cones
Possible or Not Possible

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Blackline Master — Geometry — Teacher’s Guide for Grade 1
Dear Parent/Guardian,

re: JUMP Math program  
Grade 1 Geometry

In mathematics, your child will soon start learning about 3-D shapes: cubes, rectangular prisms, spheres, cylinders, and cones. For our class activities, we will need a lot of different objects that look like, or almost look like, these 3-D shapes, such as:

- boxes of all shapes and sizes (e.g., juice boxes, cereal boxes, pasta boxes, tissue boxes)
- dice
- blocks
- unopened cylindrical cans of all shapes and sizes (e.g., soup cans, tuna cans, vegetable cans, pop cans)
- other cylindrical items (e.g., unused paper cups and straws, water bottles (washed), paper towel and toilet paper rolls, hockey pucks)
- spherical balls of any size (e.g., basketballs, soccer balls, tennis balls, table tennis balls)
- waffle cones or sugar cones
- party hats
- other shapes for comparison (e.g., egg-shaped items, pyramids, or non-rectangular prisms)

Over the next two days, please collect as many of these objects as possible, and send them to school with your child. Label any that you would like back. Please do not send any glass objects. Thank you!