Mathematics

Planning Guide

Grade 2 *3-D Objects*

Shape and Space
(3-D Objects and 2-D Shapes)

Specific Outcomes 6, 7

This Planning Guide can be accessed online at:
http://www.learnalberta.ca/content/mepg2/html/pg2_3dobjects/index.html

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Strand: Shape and Space (3-D Objects and 2-D Shapes)
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This *Planning Guide* addresses the following outcomes from the Program of Studies:

Strand: Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcomes:

6. Sort 2-D and 3-D objects, using two attributes, and explain the sorting rule.
7. Describe, compare and construct 3-D shapes, including:
   - cubes
   - spheres
   - cones
   - cylinders
   - pyramids.

Curriculum Focus

This sample targets the following changes to the curriculum:

- The general outcome focus has not changed. Both curricula have the umbrella goal: "describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them." However, at each grade level in the 1997 document the general outcome varied. For Grade 2 the general outcome stated: "Name, describe and construct a variety of 3-D objects and 2-D shapes". The change was made to ensure that students are not just rote learning to name and describe 3-D objects. The students should now focus on a study of the attributes of each class of 3-D objects. This knowledge will provide a basis for students to compare and contrast the different groups of 3-D objects.
- The specific outcomes have changed significantly. In the previous curriculum, Grade 2 specific outcomes focused on 3-D objects. The current curriculum has maintained the study of those objects, but with a shift to comparing from naming and identifying. Both curricula expected students to construct a 3-D object or its skeleton and describe cubes, spheres, cones, cylinders and pyramids in Grade 2. The previous curriculum specified that Grade 2 students should explore faces, edges and vertices of 3-D shapes. This is still necessary to meet the specific outcome that requires describing, comparing and constructing 3-D objects. This is to prepare students for the Grade 3 expectation that students will describe 3-D objects according to the shape of their faces and the number of edges and vertices. Grade 1 students now sort 3-D objects according to one attribute instead of two, and replicate composite 3-D objects instead of building a given 3-D object. The 2007 curriculum is designed around systematic incremental development that is grounded in students constructing concepts to provide a firm foundation for problem solving and more sophisticated learning in successive strands.

What Is a Planning Guide?

Planning Guides are a tool for teachers to use in designing instruction and assessment that focuses on developing and deepening students' understanding of mathematical concepts. This tool is based on the process outlined in *Understanding by Design* by Grant Wiggins and Jay McTighe.

Planning Steps

The following steps will help you through the Planning Guide:

Step 1: Identify Outcomes to Address

Guiding Questions

- What do I want my students to learn?
- What can my students currently understand and do?
- What do I want my students to understand and be able to do based on the Big Ideas and specific outcomes in the program of studies?

Big Ideas

- Three-dimensional objects can have two dimensional representations. Shading can be used to distinguish 3-D objects in 2-D representation, such as shading in a circle into a sphere. Dotted lines show hidden edges.
- Three-dimensional objects can be identified and described based on properties such as the number and shape of faces and edges and the number of vertices.
- The faces of a 3-D object are related to 2-D shapes.
- Three-dimensional shapes can be seen from different perspectives. When a 3-D object is moved in space, not all the same faces, vertices or edges may be visible; however, the 3-D object retains all these same properties no matter what its orientation in space.
- Similar 3-D objects exist in a variety of sizes, but retain the properties of their class of 3-D objects.
- Examples of 3-D objects can be found in the environment.

Sequence of Outcomes from the Program of Studies

See http://education.alberta.ca/teachers/core/math/programs.aspx for the complete program of studies.

Grade 1

Specific Outcomes

2. Sort 3-D objects and 2-D shapes, using one attribute, and explain the sorting rule.

3. Replicate composite 2-D shapes and 3-D objects.

Grade 2

Specific Outcomes

6. Sort 2-D shapes and 3-D objects, using two attributes, and explain the sorting rule.

7. Describe, compare and construct 3-D shapes, including:
   - cubes
   - spheres
   - cones
   - cylinders
   - pyramids.

Grade 3

Specific Outcomes

6. Describe 3-D objects according to the shape of the faces and the number of edges and vertices.

Step 2: Determine Evidence of Student Learning

Guiding Questions

- What evidence will I look for to know that learning has occurred?
- What should students demonstrate to show their understanding of the mathematical concepts, skills and Big Ideas?

Using Achievement Indicators

As you begin planning lessons and learning activities, keep in mind ongoing ways to monitor and assess student learning. One starting point for this planning is to consider the achievement indicators listed in the *Mathematics Kindergarten to Grade 9 Program of Studies with Achievement Indicators*. You may also generate your own indicators and use them to guide your observation of students.

The following indicators may be used to determine whether or not students have met specific outcomes 6 and 7. Can students:

- distinguish the differences between two given pre-sorted sets, and explain the sorting rule?
- identify and name two common attributes of items within a given sorted group?
- sort a given set of 3-D objects, according to two attributes, and explain the sorting rule?
- identify common attributes of cubes, spheres, cones, cylinders and pyramids from given sets of the same 3-D objects?
- identify and describe given 3-D objects with different dimensions?
- identify and describe given 3-D objects with different orientations?
- create and describe a representation of a given 3-D object, using materials such as modeling clay?
- identify examples of cubes, spheres, cones, cylinders and pyramids found in the environment?

Sample behaviours to look for related to these indicators are suggested for some of the activities listed in **Step 3, Section C: Choosing Learning Activities** (p. 9).

Step 3: Plan for Instruction

Guiding Questions

- What learning opportunities and experiences should I provide to promote learning of the outcomes and to permit the students to demonstrate their learning?
- What teaching strategies and resources should I use?
- How will I meet the diverse learning needs of my students?

A. Assessing Prior Knowledge and Skills

Before introducing new material, consider ways to assess and build on students' knowledge and skills related to 3-D objects and 2-D shapes. Have 3-D objects available for the students to use as needed. Examples of assessments include the following:

- Give students a set of familiar 3-D objects (such as a cone drinking cup or foam shape, a cube die or block, a box that is a rectangular prism such as a shoe box, a ball for a sphere, a cylinder can or toilet paper roll with the ends covered, and an egg shape such as a plastic Easter egg or a foam shape) and ask the students to sort them with a given sorting rule based on one attribute, such as the following:
  - can roll
  - can slide
  - has at least one point or vertex.

  This may be done as a class first to connect the new learning to what students have already mastered. Individual structured interviews need only be done with students for whom you have reason to be concerned about the extent of their prior knowledge.
- Can students create their own sorting rules according to one attribute and apply them to 3-D shapes? Can students explain their rules? Organize the students in groups of three or four, if you have enough 3-D shapes for your groups to operate simultaneously. If not, the activity can be done as an activity centre or with you while the rest of the class works on other tasks. Listen for the level of language used in their rules as it will give you information of their understanding of the concept. Do they have more than one or two ways to sort the 3-D objects? Are there students who can only mimic the ways to sort that have already been shared? Are there students whose sorts do not match their rules? Do they recognize why when shown? Do they repeat the same error? Use these questions to identify students with whom you wish to conduct structured interviews.
- When students are shown a pre-sorted set of 3-D objects, can they determine the differences and explain a possible rule that may have been used to sort them? This can be done as a whole class first, then in small groups and finally as a structured interview with a particular individual for whom you have concerns.
- Can students select the necessary 3-D objects from a given set to reproduce a given composite 3-D object? Probably this will have to be set up as an activity centre due to the number of 3-D shapes that would be required for a whole class.

- Can students predict and select the 3-D objects used to produce a composite 3-D object and verify their selection by deconstructing the composite object? This can originally be done by a student as the class observes to introduce the activity. Then it can be set up as an activity station.
- Can students describe the following 2-D shapes and their properties: triangle, square, circle and rectangle? Can they use what they know about these shapes to describe other 2-D shapes such as a pentagon, octagon or hexagon, even though they may not know the names of these polygons? You will have this information from the assessment of the Grade 2 Curriculum Shape and Space assessments for Outcomes 6 and 8.

If a student appears to have difficulty with these tasks, consider further individual assessment, such as a structured interview, to determine the student's level of skill and understanding. See **Sample Structured Interview: Assessing Prior Knowledge and Skills** (p. 8).

Sample Structured Interview: Assessing Prior Knowledge and Skills

Name: **Directions**	Date: **Not Quite There**	**Ready to Apply**
Provide the student with about eight 3-D objects, including a sphere, a cone and an egg-like shape and ask the student, **"Please sort these into sets of those that can roll and those that cannot."** After the student sorts, ask **"Please tell me about your sort and how you decided where to place objects."** If the student considers objects with no curved surfaces, such as cubes, able to roll based on the idea of rolling dice, you need to establish that we do not consider them rolling in math if you have to throw it to make it roll. Ask the student to sort again with that in mind.	• Does not attempt to sort. • Finds an object that will roll, such as a sphere, but does not include a cone or egg-like shape.	• Sorts the 3-D objects appropriately.
Present the student with a number of 3-D objects. Say, **"Sort the following 3-D objects by a different rule that you made up and tell me about the rule when you are done."** If the student successfully completes one more sort, ask, **"Could you sort them again by another rule and tell me about it?"** Repeat once or twice more to establish the level of flexibility and language the student has attained.	• Cannot think of a rule to sort by and so does nothing or repeats sorting by the rule that an object can roll. • Sorts the objects by those that can slide or one additional way, but cannot think of any others.	• Sorts the 3-D objects correctly in three or more ways, demonstrating flexibility and sufficient language to describe the rules at a beginning level.
Present the student with a set of 3-D objects pre-sorted by one attribute. Say, **"What was my sorting rule?"**	• Does not give a sorting rule. • Gives an incorrect or insufficient sorting rule.	• Gives the rule correctly with sufficient description to be clearly understood.

B. Choosing Instructional Strategies

Consider the following general strategies for teaching the Grade 2 outcomes regarding 3-D objects:

- Access prior knowledge on 2-D shapes so that students recognize the properties of these shapes to apply to faces of 3-D objects.
- Draw students' attention to the relationships that exist between their study of 2-D shapes and 3-D objects. For example, point out how there were 2-D shapes of various sizes and there are 3-D objects of varying sizes, but their properties remain constant. Likewise, change in orientation does not alter the properties of either a 2-D shape or a 3-D object.
- Include many hands-on activities to establish a kinesthetic knowledge of these 3-D objects, some of which they can readily experience in their daily lives and others of which they seldom handle.
- Through various construction mediums ranging from clay to mini-marshmallows and toothpicks, allow the students to produce both solids and skeletons of 3-D objects.
- Have the students share their ideas about sorting various sets of 3-D objects and provide follow-up activities to address any misconceptions that may arise.
- Have the students justify their thinking by explaining their sorting rules for 3-D objects.
- Encourage flexible thinking by having the students sort sets in more than one way.
- Have the students look for items in their environment that are one of the 3-D shapes they are studying or a composite of several of these shapes. For example, they may recognize pipes and cans as cylinders.

C. Choosing Learning Activities

The following learning activities are examples that could be used to develop student understanding of the concepts identified in Step 1.

Sample Activities:

1. **Recognizing Family Members** (p. 10)
2. **What's My Rule?** (p. 11)
3. **Getting to Know 3-D Objects and Developing Language to Describe Them** (p. 12)
4. **Student Sorts of 3-D Objects** (p. 13)
5. **Varying Perspectives of 3-D Objects** (p. 14)
6. **Constructing 3-D Objects** (p. 15)
7. **3-D Objects in the Environment** (p. 16)

Sample Activity 1: Recognizing Family Members

1. **3-D Playground Sorts**
   To help students recognize the attributes of 3-D objects used to classify them, have them focus on similar 3-D objects with the same properties, but in various in sizes. For this you need a number of the same 3-D objects in various sizes. You may be able to form such sets with plastic and wooden sets commercially available and foam forms or other common objects. Start with cubes, as they are very familiar to the students and easier for them to describe than spheres. Mixing one other kind of object with these will help students realize that they already can distinguish various families of 3-D shapes. Now they just need to be able to put their knowledge into words and refine their descriptions. Tell the students that two families of 3-D objects were playing in the schoolyard when the principal came out to tell the one family that their parents were here to pick them up and they needed to come to the office to meet them. Ask the students if they can help the principal sort out the two families, so that only the one family is given the message to come to the office. Students will easily sort the cones from the cubes. Then ask the students if they know the names of these families. They are likely to know the names for cones and cubes. Then ask them to consider how we could tell the principal what to look for so the principal would know how to tell a cone from a cube. Make a list of the attributes given under each family name. Student language such as "points" can be written and the mathematical term "vertex" supplied and written along side the student language. Proceed over a few days with additional families joining in on the playground or at a picnic, adding a new family each day. The repetition of the characteristics of the families already studied will reinforce the knowledge of their attributes, but will also serve as a guide for considering the similarities and differences of new families according to these same criteria. The spheres are likely best done last as they can be the most difficult to describe.

2. **Which One of These Things Doesn't Belong?**
   Now that students have knowledge of the attributes of each of the classes of 3-D objects to be studied at this level, they can practise identifying the same objects with different dimensions and using their language to justify their reasoning. Place three 3-D objects in front of the students, two of which are the same except for their dimensions and one of which is a different 3-D object. Ask the students to identify which one doesn't belong and explain why.

Sample Activity 2: What's My Rule?

1. Have the students look at pre-sorted 3-D objects and determine your sorting rule. This can be done as a game. If the first person in a team answers correctly, that team is given a point and the first person in the next team is given a second pre-sorted group. However, if the first person in the first team does not give a complete or accurate rule for the first set, a person from the second team has an opportunity to give a sorting rule. If that person is correct, a new sort is shown to the lead person in team three. If the second row person's rule was incomplete or inaccurate, the first person in team three is given the opportunity to provide a rule. This game may extend over a number of days.

2. Have students in small groups take turns sorting objects according to two attributes. Have the rest of the group identify the sorting rule and explain it.

Sample Activity 3: Getting to Know 3-D Objects and Developing Language to Describe Them

1. What Am I?

This activity has several variations. You will need an opaque bag or covered box with holes in the side through which students may put their hands. Inside the bag or box are placed 3-D objects. Students reach in and find an object. After feeling it, they identify it from a set of 3-D objects outside the box that is identical to those within the box. Should you not have a second identical set of 3-D objects available, you may have students point to the shape either in a series of photos taken with a digital camera and printed or 3-D diagrams. If you use 3-D diagrams, make sure that you have spent time with the students discussing how a 3-D shape is represented two dimensionally. For example, unless the students know that a circle is unshaded, but a sphere is shown by shading, they may both be interpreted as circles. If you use drawings of 3-D shapes with dotted lines representing the unseen edges, the students will need to know what the dotted lines mean. To help them develop this knowledge, various 3-D objects should be viewed from a variety of perspectives. Ask the students what they see from each angle. Does the object still have the faces, edges and vertices that they cannot see from another perspective? How can an artist show you what is hidden from view?

2. Make a Word Picture of What You Feel

To develop the language students need to describe 3-D objects, ask them to take turns describing the object they are touching to their groups. For example, a student may say when describing a sphere, "My 3-D object has no edges, faces or vertices. It has a curved surface. It feels the same all over. It may roll, no matter which part of it you place on the ground." Originally students may start out describing a sphere as a ball. Through their exploration and development they will need to come to recognize the properties that can be used to describe and distinguish 3-D shapes. Some discussion of shapes with curves may help them understand the distinctions. For example, a familiar shape that has vertices and a rounded surface would be a football. A commonly known shape with edges, but no vertices would be a flying saucer. The group is to identify the object from the description and then check its answer by removing the object from the box.

3. Yes or No?

Using a box or bag and 3-D shapes as in activity 1, ask one student to find an object to feel and identify. The group may ask questions that can be answered with either yes or no, but cannot directly ask if the item is a particular 3-D object. Students may ask questions such as:

- "Can it roll?"
- "Does it have straight edges?"
- "Does it have any faces?"
- "Does it have a curved edge?"
- "Does it have a point/vertex?

When all the members of the group agree on the identity of the 3-D object that is hidden, they ask the holder to reveal it to them so they can verify their answer.

Sample Activity 4: Student Sorts of 3-D Objects

When preparing students for sorting activities, use the following steps to focus students on the characteristics of the objects and comparing and contrasting two characteristics at a time.

1. Have the students in small groups take turns selecting a 3-D object at random and telling one or two things that they find interesting about the object.

2. Then have the students pick two 3-D objects from the set and state a way they are alike and a way they are different.

3. Have the students next pick two 3-D objects from the set and state two ways they are alike.

4. Finally place one 3-D object in the middle of the table. Have the group determine a rule for a group that it represents. For example, if a cylinder were placed in the middle of the table, the students might state their sorting rule as: "The 3-D shapes in this set must have at least one flat surface and one curved surface." The students would sort the rest of their 3-D objects based on whether they belonged in the group with the cylinder or not. When the group has shown you their sort and told you their rule, challenge the group to pick another 3-D object, another rule and sort again.

Sample Activity 5: Varying Perspectives of 3-D Objects

1. **Mystery 3-D Objects**
   In preparation for this activity, ask the student to look through a peephole cut in the end of a covered shoebox and describe what they see. Inside the box, place a 3-D object. You may want to tape it in place if the box is going to be moved. Create a second box with a duplicate of the same object positioned at a different angle or adjust the first object to another angle. Ask the students to describe what they observed. If you are using the same box and adjusting the angle of the object inside, ask the students how it is that you have not changed the shape in the box, but their descriptions are different? Lead students to understand that what they see looks different depending on which part of the object they are viewing or their vantage point. An alternative is to make peep holes in several sides of the box. Photos of a few common objects taken from varying perspectives as mystery photos can help the students understand how perspective changes what you see. For example, photos of the same chair taken from the above, front, back and side may all look quite different.

2. **Match-up**
   Show students photos of the 3-D objects taken from different perspectives and have them match them to a set.

Sample Activity 6: Constructing 3-D Objects

1. **Clay or Plasticine 3-D Objects**
   Ask the students to create 3-D objects using Plasticine or modeling clay. They will likely have little trouble making approximations of spheres, cylinders and cubes, but may find the cones and pyramids more difficult. Through a problem solving discussion, they may come up with ideas for instruments that would make it easier to make these objects.

2. **Skeletons of 3-D Objects**
   Ask the students to create the skeleton of a given 3-D object using a variety of materials. For example, if you want students to see how a triangular-based and square-based pyramid are alike and different, you might give the students mini marshmallows and toothpicks and ask them to make the skeletons of these two 3-D objects and then describe them. Ask the students how many toothpicks and marshmallows each object required. Ask what part of the object the toothpicks represent and what part the marshmallows represent; i.e., edges and vertices. Skeletons can also be made with straws or stir sticks and Plasticine corners. Pipe cleaners can be used instead of Plasticine with straws. Flexible straws can be sliced lengthwise from the tops to the flexible portion and then joined together, thus using the flexible portions to make the vertices. Very large skeletons can be made by rolling three full sheets of newspaper very tightly on the diagonal and securing each roll with masking tape to create a rod. Students can then fasten the rods together with masking tape. These methods for making skeletal constructions are not suitable for making cones, spheres or cylinders.

3. **Building a Cube from a Net**
   Have the students build a cube from a net, so that they realize that 3-D shapes can be built from 2-D nets. This will help students see the six faces of a cube. They can stick a happy face sticker on each face as they count the faces to ensure they don't miss any or double count. They also can use a marker to run along each edge as they count it so that they can be sure they counted them all. With a partner, they can each touch four vertices so they can be sure they have counted all the vertices/points. Alternatively, have the students cut apart a box and look at the net it creates.

4. **Construction of 3-D Objects with Commercial Materials**
   A class set of Polydrons or Geoshapes allows students to build 3-D shapes by snapping together the faces. This will likely need to be set up as an activity centre or station as it is unlikely that you will have enough for all your students to use at once. These tools can be used during a structured interview for one-on-one testing of student knowledge of cubes and pyramids.

Sample Activity 7: 3-D Objects in the Environment

1. **A Bulletin board**
   "I Spy 3-D Objects" could be the title of a bulletin board used to display photos or pictures cut from magazines showing 3-D objects observed in the environment. A note to parents could encourage families to submit photos for the bulletin board. You could also take students on a walk with toilet paper or paper towel rolls as their spy glasses to find 3-D objects in the school or neighbourhood. Take along a digital camera to snap photos for your bulletin board.

2. **3-D Booklets**
   Have the students create 3-D booklets in that they draw or paste pictures of things that correspond to various 3-D shapes (Alberta Education, 1990, pp. 74–76).

Step 4: Assess Student Learning

Guiding Questions

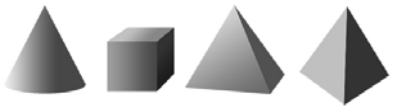
- Look back at what you determined as acceptable evidence in Step 2.
- What are the most appropriate methods and activities for assessing student learning?
- How will I align my assessment strategies with my teaching strategies?

In addition to ongoing assessment throughout the lessons, consider the following sample activities to evaluate students' learning at key milestones. Suggestions are given for assessing all students as a class or in groups, individual students in need of further evaluation, and individual or groups of students in a variety of contexts.

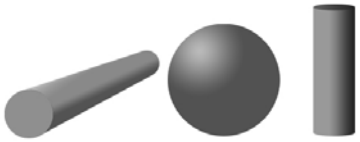
A. Whole Class/Group Assessment

1. These 3-D objects were sorted using a two attribute rule. Clearly explain the rule they were sorted by.

Follows the Rule



Does Not Follow the Rule

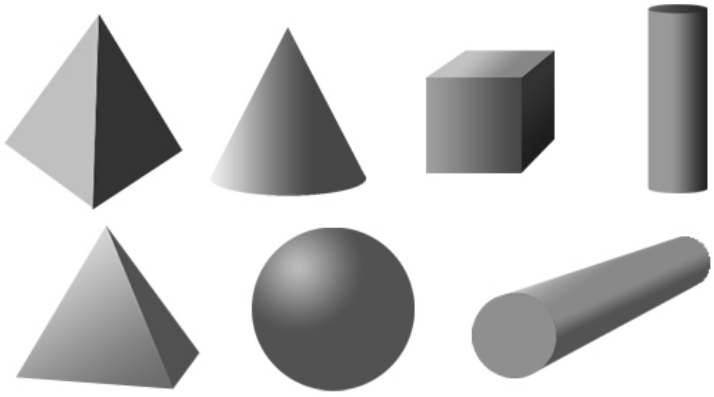


Rule: _____

_____

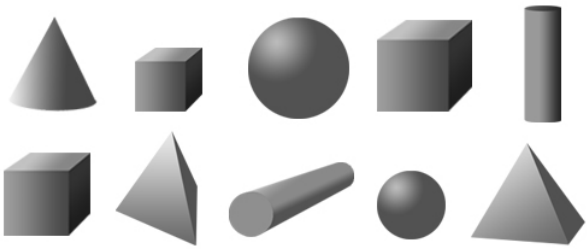
_____

2. Sort the following by printing an "R" on the 3-D objects that follow the rule and an "X" on those that do not.



Explain why you sorted each shape into the group that you did.

3. Mark a "C" for *cube* on all the members of the *cube* family below. Then write three things that they all have that let you know they belong to the *cube* family.



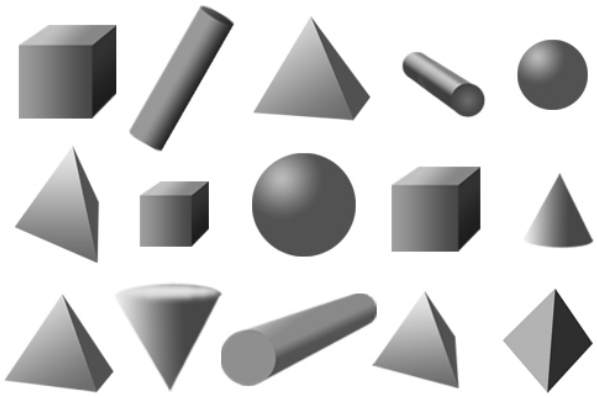
Three reasons I know that these 3-D objects belong to the *cube* family are:

a. _____

b. _____

c. _____

4. Circle all the members of the cylinder family in the 3-D objects below.

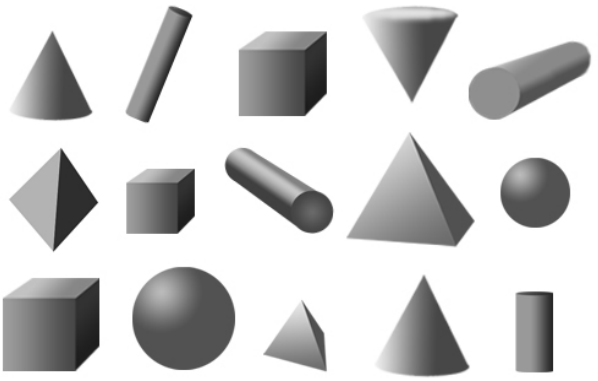


Two reasons that I know these 3-D objects belong to the cylinder family are:

a. _____

b. _____

5. Circle all the members of the pyramid family in the 3-D objects below.



Two reasons that I know these 3-D objects belong to the pyramid family are:

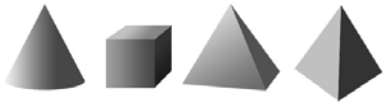
a. _____

b. _____

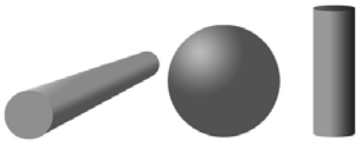
Whole Class/Group Assessment Key

1. These 3-D objects were sorted using a two attribute rule. Clearly explain the rule they were sorted by.

Follows the Rule

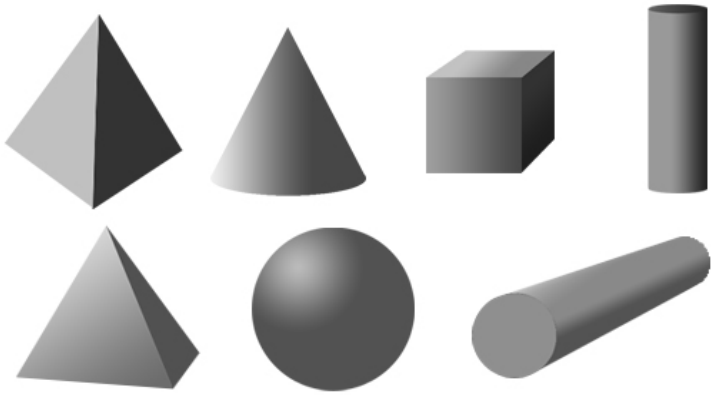


Does Not Follow the Rule



Rule: These objects all can slide and have at least one point or vertex.

2. Sort the following by printing an "R" on the 3-D objects that follow the rule and an "X" on those that do not.



Explain why you sorted each shape into the group that you did.

The sphere can roll, but does not have any faces, so it did not belong in the group that followed the rule.

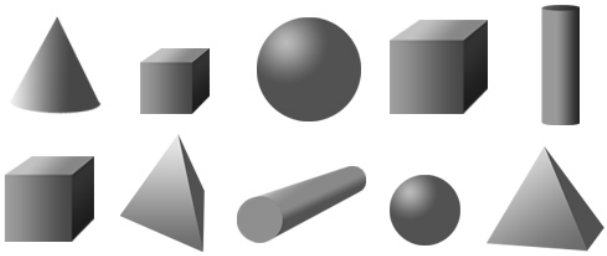
The 2 cylinders have 2 round faces and can roll, so they belonged in that group that follows the rule.

The pyramids have no round faces and cannot roll, so they did not belong in the group that follows the rule.

The cube has no round faces and cannot roll, so it does not belong in the group that follows the rule.

The cone has one round face and can roll, so it belongs in the group that follows the rule.

3. Mark a "C" for *cube* on all the members of the *cube* family below. Then write three things that they all have that let you know they belong to the *cube* family.



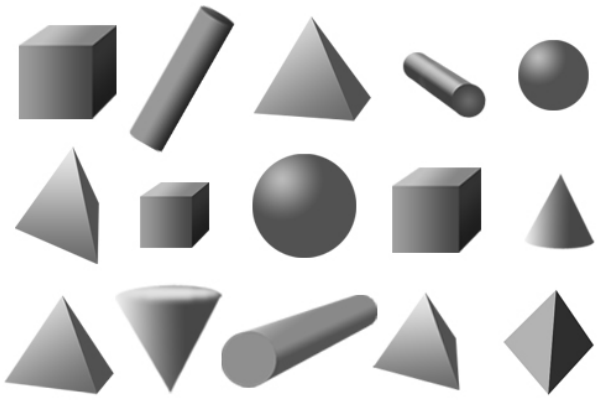
Three reasons I know that these 3-D objects belong to the *cube* family are:

a. They have six square faces or all the faces are square.

b. All the edges are straight line edges.

c. There are more than five or there are eight vertices or points.

4. Circle all the members of the cylinder family in the 3-D objects below.

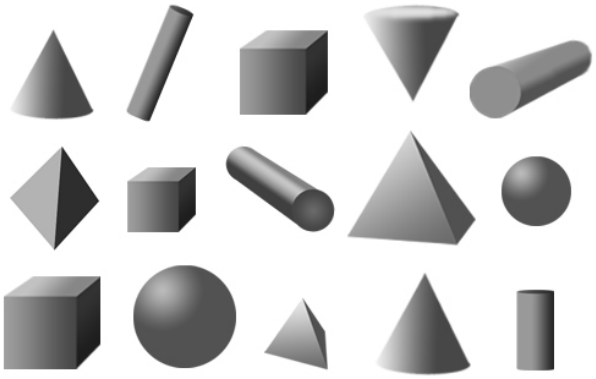


Two reasons that I know these 3-D objects belong to the cylinder family are:

a. They have two round circular faces.

b. They have a curved or rounded surface and can roll.

5. Circle all the members of the pyramid family in the 3-D objects below.



Two reasons that I know these 3-D objects belong to the pyramid family are:

a. They have one vertex above the center of the base or they have 4 or 5 vertices/points or they have a square or triangular face for a base.

b. They have some triangular faces. (Students may or may not state that there are 4 of these.)

B. One-on-one Assessment

1. Present the student with 3-D objects pre-sorted according to two attributes. Ask the student to tell you the sorting rule and how it was used to decide in which group to place each 3-D object.

Rubric for Identifying and Explaining the Rule Used to Sort 3-D Objects

Not Yet	Needs More Instruction	Achieved	WOW!
• Does not sort or seems to randomly assign the objects to two or more groups.	• Identifies one attribute of the rule used to sort, but not the other. • Seems to have the idea of the two attributes used, but cannot express the rule clearly.	• Is able to put into words clearly the rule used including both attributes, but the explanation focuses on the specific 3-D objects in the sets.	• Not only identifies the rule with both attributes clearly, but in the explanation makes it clear that the attributes apply to all the 3-D objects in that classification, such as "all cones have one vertex and can roll".

2. Present the student with a variety of 3-D objects. Direct the student to sort them according to a rule based on two attributes and explain to you how it was done. If successful with the first sort, ask for a second sort to insure the student has alternatives and is not just recalling one sort and how it worked from class activities.

Rubric for Sorting 3-D Objects According to Two Attributes

Not Yet	Needs More Instruction	Achieved	WOW!
• Does not sort or seems to randomly assign the objects to two or more groups.	• Sorts according to one attribute only. • Sorts according to two attributes, but is unable to clearly express and explain the rule used. • Cannot do a second sort.	• Sorts accurately by a two attribute rule and clearly expresses and explains the rule. • Does a second sort equally well using different attributes.	• Sorts according to two attributes several times correctly. • Expresses and explains the rules well and includes references to attributes applying to all the 3-D objects in the class.

Step 5: Follow-up on Assessment

Guiding Questions

- What conclusions can be made from assessment information?
- How effective have instructional approaches been?
- What are the next steps in instruction?

A. Addressing Gaps in Learning

Students who have specific gaps in learning should have these addressed with activities that provide ways to master the missing concept, knowledge or skill. An assessment indicator of the level of maturity in geometric learning is whether or not the student applies the language or knowledge to only the specific objects at hand. This is a beginning level. When the student begins to speak about the attributes as being characteristics for the complete class of 3-D objects, then the student has moved to a higher level. For a more complete analysis of the Van Hiele Theory of Geometric Thought, see pages 188–193 of *Teaching Student-Centered Mathematics: Grades K–3* (2006) by John A. Van de Walle and LouAnn H. Lovin.

One of the difficulties in teaching geometry at primary grades is a need for good resources for definitions. The Van de Walle and Lovin text referred to above has a good description of 3-D objects on page 205 and a good set of 3-D pictures on page 206, including some non-examples, which are seldom provided. A good glossary and a set of nets are provided on pages 181–207 of *Diagnostic Mathematics Program, Division I, Geometry* (1990) by Alberta Education.

B. Reinforcing and Extending Learning

Students who have achieved or exceeded the outcomes will benefit from ongoing opportunities to apply and extend their learning. These activities should support students in developing a deeper understanding of the concept and should not progress to the outcomes in subsequent grades.

Consider strategies, such as the following.

- Provide information to parents about the specific outcomes expected of Grade 2 students so that parents can reinforce student learning by pointing out 3-D objects at home and in the community.
- Provide opportunities for students to play with 3-D shapes in learning centres in their free time. Activities that students might enjoy could include building a skeleton for one of the objects or finding the object that matches a card with its various faces on it. Students could also match pictures of items from the environment with the 3-D shapes to which they correspond. Students could do sorts for other students to guess their sorting rule. Matching riddle cards to the correct shape (Alberta Education, 1990, pp. 78–79). For example, a card could state: "I have one point/vertex. I can roll. I have one face that is circular. What am I?"

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