Lesson Summary:
In this lesson, students sort two-dimensional shapes and identify and describe attributes of the shapes. Attributes for sides (congruent, parallel, perpendicular) and angles (congruent, acute, obtuse, right) are investigated. Then, students compare two-dimensional shapes with three-dimensional figures. They identify attributes of three-dimensional shapes such as cones, cylinders, prisms, pyramids and spheres. Students describe and compare the attributes and build models with physical materials.

Estimated Duration: Three hours

Commentary:
Students at grade four begin to analyze, classify and describe relationships in two-dimensional shapes and three-dimensional objects in more sophisticated ways. They can use attributes and relationships of sides, angles, faces and vertices to classify and describe. Encourage the use of precise mathematical language as students explore attributes. Models and visual representations provide the tools needed to develop spatial sense and meet the needs of a variety of learners. This foundation will allow students to begin making informal deductions (Crowley, 1987) as they progress through the study of geometric concepts.

Pre-Assessment:
Part One
- Distribute, Two-Dimensional Shapes, Attachment A to pairs of students.
- Have students sort the shapes and identify the attributes used for sorting. Observe attributes the students use to sort the shapes.
- Have pairs share the sorted shapes with the class or another pair. Record the attributes on chart paper.

Scoring Guidelines:
This is an informal assessment to identify the attributes of shapes with which students are most familiar. Expect sorting to focus on the number of sides and angles. Students using attributes such as parallel and perpendicular lines, regular and irregular shapes or types of angles are approaching expectations.
Classifying Shapes and Figures – Grade Four

Part Two
This informal assessment is completed at the beginning of part two in the lesson.

• Distribute copies of Two- and Three-Dimensional Figures Pre-Assessment, Attachment B, to students.
• Direct students to individually complete the pre-assessment.

Scoring Guidelines:
Assess the attributes students use to sort the two- and three-dimensional shapes. Informally assess for attributes learned in Parts One and Two of the lesson and determine which students use the attributes and apply them to the three-dimensional figures. Expect students to use the number of faces, corners (vertex) and edges when describing the figures.

Post-Assessment:
Distribute Two- and Three-Dimensional Figures Post-Assessment, Attachment C, to students. Have students complete the assessment individually

Scoring Guidelines:
An answer key and rubric is provided on Post-Assessment Answer Key, Attachment D.

Instructional Procedures:
Part One – Two-dimensional Shapes

Instructional Tips:
• Provide instruction about parallel and perpendicular lines, congruency and/or angle types throughout the lesson if students have not had previous instruction.
• Use a modeling strategy, such as a “think-aloud” to sort the shapes using one attribute and record the sorting for students to observe.

1. Brainstorm a list of attributes about two-dimensional shapes. Build on the list from the pre-assessment. Ask questions to expand and clarify attributes such as:
   • What are possible attributes that can describe the sides? (two sides can be parallel, two sides can be perpendicular, all of the sides of the shape are congruent, opposite sides of the shape are congruent)
   • What are possible attributes that can describe the angles? (Types of angles – right, acute, obtuse, all angles are congruent or equiangular pairs of angles are congruent.)

   Have the students record the attributes in a journal. Post the attributes on a word wall.

2. Have the students select one attribute describing sides to sort their shapes. Observe students as they sort. Ask students about the attribute they chose and the shapes they include in their groupings.

3. Select students to share their sorting with the class or others. Have students evaluate how the shapes are sorted by the attribute.

4. Direct the students to select one attribute describing angles to sort their shapes. Observe students as they sort. Ask students about the attribute they chose and the shapes they include in their groupings.
Classifying Shapes and Figures – Grade Four

5. Select students to share their sorting with the class or others. Have students evaluate how the shapes are sorted by the attribute.

6. Continue to have students sort shapes using a variety of attributes. Have them record their sorting in journals, and share and compare with partners. Encourage students to use precise mathematical language in their discussion and writings.

7. Have the students summarize how shapes can be sorted using attributes of sides and angles in a mathematics journal. Select students to share their journal entries with the class or a few students.

8. Review the list of attributes for sides and angles. Distribute geoboards or dot paper to the students.

9. Explain the activity to students. Students use the geoboard to create shapes that fit given attributes.
   a. Provide a description of a shape. For example: A quadrilateral with four congruent sides and four (right/congruent) angles.
      Additional examples include:
      - hexagon with two right angles
      - concave quadrilateral with one right angle
      - pentagon with one set of parallel sides
      - triangle with two right angles (impossible)
   b. Make the shape on the geoboard.
   c. Share shapes with the class or others.

10. Review terminology that is new to students such as concave. Have them observe different concave shapes and discuss what makes a shape concave. Have them write a definition in their own words and sketches of concave shapes in their journals.

11. Select two shapes for students such as a rhombus and a square. Have students sketch and compare the two shapes, discuss and then write things that are similar and different in a journal.

12. Provide additional pairs of shapes having a variety of attributes for students to compare, discuss and write about in journals. Have students sketch the shapes and use Venn diagrams to model the comparison.

Part Two – Three-Dimensional Figures

Instructional Tip:
Provide models of geometric solids and shapes (from a tangram or attribute set) to groups of students. If models are not available use Two- and Three-Dimensional Figures Pre-Assessment, Attachment B or real-world models of geometric solids for the activity (cracker box, oatmeal or potato chip canister, orange cones, etc.)

13. Conduct Part Two Pre-Assessment activity.
   a. Distribute models or Two- and Three-Dimensional Figures Pre-Assessment, Attachment B to pairs of students.
   b. Have the students sort the figures.
Classifying Shapes and Figures – Grade Four

c. Observe students as they sort and note attributes used to classify the shapes. Expect students to sort using attributes such as shape (e.g., circles, cones and cylinders or triangle and pyramids) or dimension (two- and three-).

14. Select students to share how they sorted the figures. Record attributes students present to the class.

15. Provide additional models of geometric solids to the students including a variety of pyramids, prisms and spheres. Allow students to observe and manipulate the shapes. Ask students to describe attributes of the solid with a partner and write ideas in a journal.

16. Select students to share responses with the class. Record additional attributes on chart paper. Have students record attributes in a journal. Attributes include round or flat surface, shape of surface, square corners (vertex), pointed vertex, congruent sides, parallel sides, etc.

Instructional Tips:

- Students may consider the sides of a cone and cylinder as faces. A face lies in one plane. The bases of cones and cylinders are faces. However, the surfaces of cones and cylinders that are curved intersect several planes. The curved surfaces are called lateral surfaces.
- It is important to note that bases are not always the top and bottom of a prism. If two faces are opposite each other and both faces are congruent and parallel, they can be considered a base. The base of prisms can change depending on the orientation of the solid.

17. Have the students sort the geometric solids using attributes from the list. As students sort they may invent or discover new attributes of the shapes. When students present their sorting add the additional attributes to the list on the chart paper. Observe students as they sort.

18. Have students present the sorted models and the attributes they used.

19. Select two of the geometric models such as a prism and a pyramid. Have students write sentences about how the attributes of the figures are alike and different. Students should select and identify the names of the figures.

20. Allow students to share with the class or in small groups.

21. Have students observe the cones, cylinders and spheres, discuss the attributes with a partner and write ideas in a journal. Select students to share ideas with the class and record on chart paper. Students should add to their lists in the journals. Clarify misconceptions or misunderstanding about curved surfaces.

22. Provide other pairs of models for students to compare and write about in journals.
Part Three

Instructional Tip:
Prepare re-sealable bags containing toothpicks and small marshmallows for each student.

23. Play a game in which students identify a shape or figure using attributes. Distribute the models of geometric solids to small groups. Give the students riddles or have them ask questions to determine the secret shape or figure.

- I am thinking of a figure that has no angles or sides. What figure am I thinking about? (sphere)
- I am thinking of a figure that has only one vertex. What figure am I thinking about? (cone)
- I am thinking of a figure that has 6 faces that are exactly the same. What figure am I thinking about? (cube)
- I am thinking about a figure that has two faces. What figure am I thinking about? (cylinder)

Instructional Tip:
As an option, draw shapes or figures on tag board. Punch holes in the upper two corners of the tag board. Tie the two ends of a 48 inch piece of string to the tag board through the punched wholes. Place the tag boards on the backs of students so they can not see their shape or figure. The students find a partner and show the partner the shape or figure on their tag board. Then they ask questions using attributes to try and guess the shape or figure. Answers given by the partner are limited to yes or no. Model questions such as,

- Is it a two-dimensional shape?
- Does it have two bases?

24. Distribute toothpicks and marshmallows to students.
25. Instruct the students to build two different three-dimensional models of geometric solids.
26. Have students create a Venn diagram comparing the two three-dimensional models in their journal. Allow students to share the journal entries with the class or in small groups.

Differentiated Instructional Support:
Instruction is differentiated according to learner needs, to help all learners either meet the intent of the specified indicator(s) or, if the indicator is already met, to advance beyond the specified indicator(s).

- Reduce the number of three-dimensional solids using one pyramid and prism. Once students understand the concept of pyramids and prisms, introduce other models of each.
- Use stirring straws and large marshmallows to build models of two- and three-dimensional shapes. Provide models of geometric figures to assist in building figures in Part Three.

Extensions:
- Have pairs of students sit across from each other. Place a folder upright between the students. One student builds a tower with the geometric solids and then describes the tower to the partner using attributes or names of the figures. The partner builds the tower and then they compare for accuracy.
Classifying Shapes and Figures – Grade Four

- Students research architectural designs of homes or buildings and identify the two-dimensional and three-dimensional shapes that make up these designs.
- Allow the students to explore three-dimensional shapes using computer software that will help them to design and construct shapes.

**Home Connections:**
Have students identify and create a list of two-dimensional and three-dimensional shapes and objects in their homes and share with the class.

**Materials and Resources:**
The inclusion of a specific resource in any lesson formulated by the Ohio Department of Education should not be interpreted as an endorsement of that particular resource, or any of its contents, by the Ohio Department of Education. The Ohio Department of Education does not endorse any particular resource. The Web addresses listed are for a given site’s main page, therefore, it may be necessary to search within that site to find the specific information required for a given lesson. Please note that information published on the Internet changes over time, therefore the links provided may no longer contain the specific information related to a given lesson. Teachers are advised to preview all sites before using them with students.

*For the teacher:* chart paper, markers, sets of geometric solids and shapes, re-sealable bags, two boxes of toothpicks and two bags of miniature marshmallows, tag board and string (optional)

*For the student:* mathematics journals, pencil, paper

**Vocabulary:**
- angle
- concave
- edge
- face
- side
- surface
- three-dimensional object
- two-dimensional shape
- vertex

**Technology Connection:**
Use computer software to design two-dimensional and three-dimensional shapes

**Research Connections:**
Classifying Shapes and Figures – Grade Four


**General Tips:**
Create a Word Wall bulletin board for mathematical vocabulary students are expected to know. Include visual representations, models and “kid-friendly” definitions. Students can use the Word Wall as a guide and a way to check their answers.

**Attachments:**
Attachment A, *Two-Dimensional Shapes*
Attachment B, *Two- and Three-Dimensional Figures Pre-Assessment*
Attachment C, *Two- and Three-Dimensional Figures Post-Assessment*
Attachment D, *Post-Assessment Answer Key*
Classifying Shapes and Figures – Grade Four

Attachment A
Two-Dimensional Shapes

E  O  F
I  N  G
J  A  M
L  B  K
H  C  D
### Two- and Three- Dimensional Figures Pre-Assessment

**Directions:** Sort the figures using an attribute.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Circle" /></td>
<td><img src="image2" alt="Cylinder" /></td>
</tr>
<tr>
<td><img src="image3" alt="Cone" /></td>
<td><img src="image4" alt="Rectangular Prism" /></td>
</tr>
<tr>
<td><img src="image5" alt="Triangular Prism" /></td>
<td><img src="image6" alt="Cube" /></td>
</tr>
<tr>
<td><img src="image7" alt="Pyramid" /></td>
<td><img src="image8" alt="Prism" /></td>
</tr>
<tr>
<td><img src="image9" alt="Cone" /></td>
<td><img src="image10" alt="Square" /></td>
</tr>
</tbody>
</table>
1. A square is a….  
   a. solid shape  
   b. three-dimensional shape  
   c. two-dimensional shape  
   d. vertex

2. Name the shape shown. ________________

List four attributes of the shape.

3. Sketch a concave pentagon with one right angle.

4. Name the figures listed below and identify at least 3 attributes of each shape.

Name of shape ________________  Name of shape ________________
Attribute 1 ________________  Attribute 1 ________________
Attribute 2 ________________  Attribute 2 ________________
Attribute 3 ________________  Attribute 3 ________________
5. Sort the shapes shown into two groups. Write the attribute and the letters of the shape in the appropriate group.

```
Group 1          Group 2

a.                b.             c.                 d.              e.
```

Explain what attribute was used to sort the figures.

6. Name the solid shape that:
   a. has two faces and no vertices. ____________________________
   b. has no faces. ____________________________
   c. has six congruent sides. ____________________________

Performance Assessment:

Construct a three-dimensional figure using marshmallows and toothpicks which has five faces, five corners and eight edges.

Name the shape.
1. A square is a….
   c. two-dimensional shape

2. Name the shape shown. hexagon

   List four attributes of the shape. Possible responses include:
   - 6 sides
   - 6 corners
   - obtuse angles
   - opposite sides are parallel
   - congruent sides

3. Example of concave pentagon with one right angle.

4. Name the figures listed below and identify at least 3 attributes of each shape.

   Name of shape   cone                     Name of shape   cube
   Attribute 1    three-dimensional               Attribute 1    three-dimensional
   Attribute 2    circular base                  Attribute 2    six faces
   Attribute 3    one vertex                     Attribute 3    parallel faces or edges

   Accept attributes which are appropriate for each figure.
5. Sort the figures shown into two groups. Write the attribute and the letters of the figures in the appropriate group.

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>a, c, e</td>
<td>b, d</td>
</tr>
</tbody>
</table>

Explain what attribute was used to sort the figures.

*Triangles and figures with triangle faces*

*Accept groupings which correspond to stated attributes.*

6. Name the solid shape that:
   a. has two faces and no vertices. *cylinder*
   b. has no faces. *sphere*
   c. has six congruent faces. *cube*

Performance Assessment:

7. Construct a three-dimensional figure using marshmallows and toothpicks which has five faces, five corners and eight edges.
   Name the shape. *Pyramid or square pyramid*
### Attachment D (continued)

#### Post-Assessment Answer Key

<table>
<thead>
<tr>
<th>Performance Level</th>
<th>Exercises 1-6</th>
<th>Performance Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exceeds Expectations</strong></td>
<td>Describes, identifies and sorts shapes and figures using attributes and relationships among the attributes in exercises 2, 3 and 5. Use appropriate mathematical vocabulary. For example: <em>The hexagon has six congruent sides, three sets of parallel sides and six obtuse angles.</em> <em>Group 1: b, d and e Group 2: a and c</em> Use parallel sides and faces to sort Sketches a concave pentagon with a right angle.</td>
<td></td>
</tr>
<tr>
<td><strong>Meets Expectations</strong></td>
<td>Describes and identifies shapes and figures using quantitative descriptions and some qualitative attributes. Begins to use mathematical vocabulary. For example: <em>The cube has six faces, six vertices and has parallel sides.</em> Sketches a pentagon with one right angle or sketches a pentagon that is concave.</td>
<td>Builds a model of a square pyramid.</td>
</tr>
<tr>
<td><strong>Approaching Expectations</strong></td>
<td>Describes, identifies and sorts shapes and figures using quantitative descriptions. Uses everyday language. For example: <em>The hexagon has six sides, corners and edges. I sorted the figures into groups using two- and three-dimensions.</em> Sketches a concave shape or a shape with a right angle.</td>
<td>Builds a figure with one or two of the attributes outlined such as a triangle prism.</td>
</tr>
<tr>
<td><strong>Intervention Needed</strong></td>
<td>Describes, identifies and sorts shapes with two or less quantitative or qualitative attributes. For example: <em>The shape has six sides. I sorted the figures using dashed lines.</em> Sketches a non-concave shape with no right angles.</td>
<td></td>
</tr>
</tbody>
</table>