GRADE 1 MATHEMATICS

Shape and Space

Grade 1: Shape and Space (Measurement) (1.SS.1)

Enduring Understandings:

Objects can be compared using the same attribute.

Essential Question:

How can objects be compared?

Specific Learning Outcome(s):	Achievement Indicators:
1.SS.1 Demonstrate an understanding of measurement as a process of comparing by ■ identifying attributes that can be compared ■ ordering objects ■ making statements of comparison ■ filling, covering, or matching [C, CN, PS, R, V]	➛ Identify common attributes, such as length (height), mass (weight), volume (capacity), and area, which could be used to compare a set of two objects. ➛ Compare two objects and identify the attributes used to compare. ➛ Determine which of two or more objects is longest/shortest by matching, and explain the reasoning. ➛ Determine which of two or more objects is heaviest/lightest by comparing, and explain the reasoning. ➛ Determine which of two or more objects holds the most/least by filling, and explain the reasoning. ➛ Determine which of two or more objects has the greatest/least area by covering, and explain the reasoning.

Prior Knowledge

Students may have had experience

- using direct comparison to compare two objects based on a single attribute, such as length (height), mass (weight), and volume (capacity)

Background Information

In Grade 1 the comparisons are not limited to two objects.

Mass is the amount of matter in an object. It is measured using a pan balance and standard masses. The mass of an object is measured in grams and kilograms.

The word **weight** is the force that gravity exerts on an object. It is measured using a spring balance. Weight is frequently used when mass is intended. Weight is measured in Newtons.

Volume is the amount of space occupied by an object (solid, liquid, or gas).

Capacity is the amount a container is able to hold.

Students need to be aware of the common usage of the word *full*. A full glass of milk is one in which the volume of milk measures less than the capacity of the glass. If students fill a glass to the brim with milk, they are likely to be told that the glass is *too full*. There are many instances of this anomaly in daily life. (e.g., a full bottle of pop, a room full of people, a box full of blocks, etc.)

Area is the measurement of the surface of a 2-D shape.

Surface refers to the outer faces or outside of an object. A surface may be flat or curved.

The concept of area incorporates the idea of covering surfaces. At this level, students are expected to learn to cover a surface without leaving any gaps. Young students need to see the relevance of area to their lives.

Mathematical Language

longer	height
shorter	cover
taller	area
almost the same	full
lighter	empty
heavier	compare
less	comparison
more	volume
bigger	capacity
smaller	mass
length	weight

Learning Experiences

Assessing Prior Knowledge

1. Brainstorm with the class ways that objects can be compared. Note the vocabulary used.
2. Set up three comparing stations each with two different objects.
   - length
   - mass (weight)
   - volume (capacity)

BLM
1.SS.1.1

Observation Checklist

Observe students as they work at the stations. Look for the following.

The students

- ❑ compare the length of the two objects from a common starting point
- ❑ compare the mass (weight) of the two objects using an effective strategy such as their hands or a balance scale
- ❑ compare the volume (capacity) of the two objects using an effective strategy such as filling one and pouring it into the second container or fitting one container into the other
- ❑ use the appropriate language for comparison at each station

- **Identify common attributes, such as length (height), mass (weight), volume (capacity), and area, which could be used to compare a set of two objects.**
- **Compare two objects and identify the attributes used to compare.**

- Hold up two different objects. Ask students how they can compare them. Record their responses.

  Now, hold up two pieces of the same type of paper, each with a different area. Ask students how they can compare them. Students should recognize that the mass of each piece of paper will be hard to compare. They should also recognize that volume cannot be used for comparison. If the idea of area is not suggested ask, "How many colour tiles (unifix cubes, square pattern blocks, etc.) do you think it will take to cover each paper? Do you think that this might be another way to compare objects?"

  Have students work in groups to find the area of different pieces of paper by covering.

- **Grab Bag:** Place a collection of objects in a bag. Students take turns reaching in and selecting two objects. Compare them using as many attributes as they can. Record your observations anecdotally.

- **Determine which of two or more objects is longest/shortest by matching, and explain the reasoning.**

- Provide students with objects of different lengths. Model the language of comparison, then have them practise comparing objects using the following words:

longer than	*shorter than*	*taller than*
longest	*shortest*	*tallest*
as long as	*as short as*	*as tall as*
not as long as	*not as short as*	*not as short as*
the same length as	*the same height as*	*not the same . . .*
different length		

Ensure that students are comparing length/height from a common starting point.

- Provide a variety of materials (pencils, straws, blocks, paper rolls, etc.). Have students select three of them and order them according to length (e.g., tallest to shortest, shortest to longest). Ask them to justify the order using comparative language. Model the language of comparison: "The yellow pencil is longer than the green pencil, but shorter than the blue."
- **Yes or No:** Students answer "yes" or "no" to a series of comparative statements and explain their thinking, for example,
  - "My desk is longer than the bookshelf."
  - "The door is taller than the whiteboard."
  - "The whiteboard eraser is shorter than the paper clip."
  - "The chart stand is shorter than the skipping rope."

Assessing Understanding: Journal/Learning Log Entry

Find an object that is shorter than your pencil and one that is longer than your pencil.

Draw and write to record what you found.

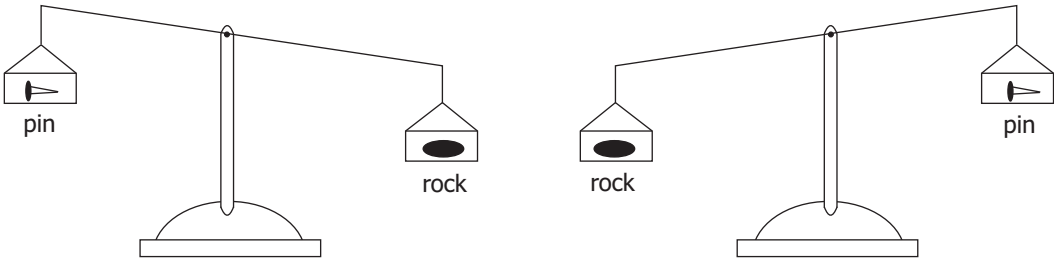
BLM
1.S.S.1.2

- **Determine which of two or more objects is heaviest/lightest by comparing, and explain the reasoning.**

- Provide students with experiences in comparing pairs of objects with significant differences in mass. This can be easily determined simply by lifting and holding one object in each hand.

  Note: As students demonstrate an understanding of significant differences in mass, introduce experiences with masses of minimal differences. This leads naturally into the need for a pan balance.

- Demonstrate the pan balance by showing what happens when two objects of different masses are placed in the pans. Exchange the objects to show that the heavier object will always be lower on the balance.



- Provide small groups with four or five different objects and a pan balance. Ask students to order the objects by mass without using the balance (estimate) and to record their estimates. Then have them compare the masses using the balance and record their results by drawing and writing.

  Model the use of frame sentences to record results. Then ask students to record their experimental results with frame sentences, such as the following:

  _____ has a greater mass than _____

  _____ has less mass than _____

  _____ has the same mass as _____

  _____ has the least mass

  _____ has the greatest mass

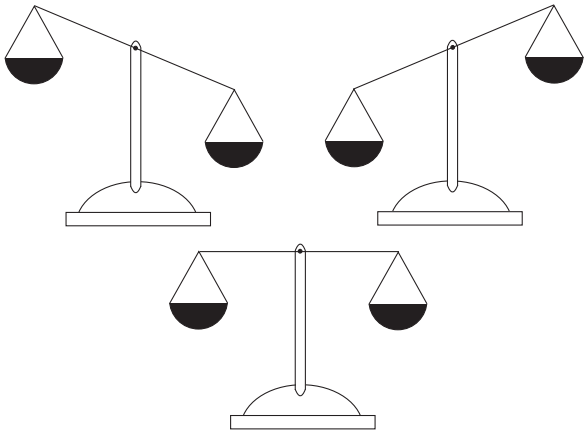
- Supply students with a malleable material such as playdough. Ask students to make two balls of different masses from the material and to verify their masses using a pan balance. Follow up: Have students make two or more balls with the same mass, and verify their masses using a pan balance.

  Observe students for strategies and language used, as well as for accuracy of models.

Assessing Understanding: Performance Task

From a collection of objects, have students compare the mass of two objects by finding objects that cause the pan balance to look like the diagrams shown. Ask students to record on the diagrams which objects make the balance look like the diagrams below.

BLM
1.SS.1.3



- **Determine which of two or more objects holds the most/least by filling, and explain the reasoning.**

- Have students explore the volume (capacity) of a variety of containers (e.g., boxes, cans, cups, jugs, scoops, spoons) with a variety of materials (e.g., water, sand, rice). Provide containers that have the same volume (capacity) but are different in shape, that are the same shape but have different volume (capacity), and those that will nest inside each other for ordering by volume (capacity). Ask questions such as
  - "Do you think there is another container that will hold the same amount of water? How could you prove it?"
  - "Which container might hold the most? How could you prove it?"

- Provide containers of varying sizes and shapes. Have students choose two containers, estimate which holds more, and check by filling and pouring. Record their findings on the chart. Choose two more containers and repeat the activity."

  Containers:

BLM
1.SS.1.4

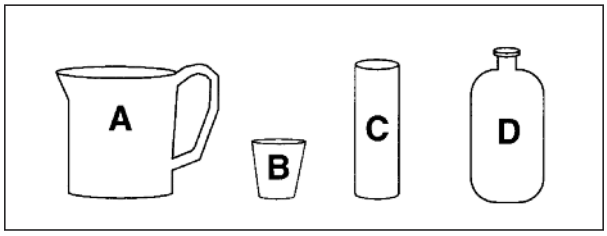


Chart:

Containers	Estimate Which Holds More	More	Less

Extend the activity by having students order the containers from least volume (capacity) to greatest.

Assessing Understanding: Performance Task

Provide three containers labelled A, B, and C. Ask students to

- ❑ predict the order of the containers from the least volume (capacity) to the greatest without filling or pouring (estimate)
- ❑ measure to confirm their predictions
- ❑ record their results
- ❑ write comparative sentences about the three containers

- **Determine which of two or more objects has the greatest/least area by covering, and explain the reasoning.**

- Draw students' attention to covering an area in natural situations, such as
  - covering a desk or table with newspaper for painting
  - putting a tablecloth on a playhouse
  - covering a doll with a blanket
- Provide opportunities for students to compare areas by
  - superimposing
  - comparing different sizes of the same shape
  - comparing different shapes

  Ask, "How do you know that the area of this is larger/smaller?" (Students will give visual clues—*I can see green around the edge where it isn't covered. It is so completely covered that I can't see the bottom one now*.)
- Allow students to explore covering areas with a variety of objects. Have them keep a record by drawing or writing. Discuss how objects must completely cover an area (discuss gaps and overlaps).
- Have students compare areas using concrete materials. For example, tell students to do the following: "Hide a shape by covering its surface with blocks. Record the number of blocks used. Hide another shape using blocks. Record the number of blocks used. Compare the number of blocks used to determine which area is larger."

  Extend the activity by having them order the shapes by area from least to greatest.

Assessing Understanding

Provide three shapes labelled A, B, and C. Ask students to

- ❑ predict the order of the shapes from the smallest area to the largest area without covering (estimate)
- ❑ measure to confirm their predictions
- ❑ record their results
- ❑ write comparative sentences about the three shapes

Performance Task: Comparison Centres

Prepare a set of cards with the words length, mass (weight), volume (capacity), and area. Depending on the size of the class you may need to duplicate some of the words.

BLM 1.SS.1.5

Divide the class into groups.

Have each group draw a word card.

Explain that the group is responsible for setting up a comparison centre based on the word they picked. Each centre should have three or four materials/objects for comparison and any other equipment necessary.

Groups need to

- select their materials and label them in some way
- compare the objects/materials
- order them in some way (group choice)
- record the order

Groups will also make up at least three comparison frames based on their materials leaving blanks for the answers. **Note:** Perhaps these can be copied and then placed at the centre to use as individual recording sheets.

Example

1. _____ has a larger area than _____.
2. _____ has a smaller area than _____.
3. _____ has the same area as _____.

Finally, have the group write the task directions for their centre.

Groups then rotate through the centres completing the activities and recording their findings.

At a class meeting have each group present the findings from their centre and answer any related questions.

Observation Checklist

- ❑ materials selected are appropriate for the concept
- ❑ correct comparisons are made
- ❑ materials/objects are ordered correctly
- ❑ appropriate comparison frames are written
- ❑ findings are clearly stated
- ❑ questions asked by other students are answered
- ❑ correct comparisons are made at each of the centres
- ❑ findings are recorded

Grade 1: Shape and Space (3-D Objects and 2-D Shapes) (1.SS.2, 1.SS.3, 1.SS.4)

Enduring Understandings:

Objects and shapes can be sorted by similarities.

Geometric shapes can be described and compared using their attributes

A 3-D object can be analyzed in terms of its 2-D parts.

Essential Questions:

How are the objects/shapes alike?

In which ways can the objects/shapes be sorted?

What is the sorting rule?

How can 3-D objects and 2-D shapes be described?

SPECIFIC LEARNING OUTCOME(S):	ACHIEVEMENT INDICATORS:
1.SS.2 Sort 3-D objects and 2-D shapes using one attribute and explain the sorting rule. [C, CN, R, V]	➔ Sort a set of familiar 3-D objects or 2-D shapes using a given sorting rule. ➔ Sort a set of familiar 3-D objects using a single attribute determined by the student, and explain the sorting rule. ➔ Sort a set of 2-D shapes using a single attribute determined by the student, and explain the sorting rule. ➔ Determine the difference between two pre-sorted sets of familiar 3-D objects or 2-D shapes, and explain a possible sorting rule used to sort them.

(continued)

Specific Learning Outcome(s):	Achievement Indicators:
1.SS.3 Replicate composite 2-D shapes and 3-D objects. [CN, PS, V]	➛ Select 2-D shapes from a given set of 2-D shapes to reproduce a composite 2-D shape. ➛ Select 3-D objects from a given set of 3-D objects to reproduce a composite 3-D object. ➛ Predict and select the 2-D shapes used to produce a composite 2-D shape, and verify by deconstructing the composite shape. ➛ Predict and select the 3-D objects used to produce a composite 3-D object, and verify by deconstructing the composite object.
1.SS.4 Compare 2-D shapes to parts of 3-D objects in the environment.. [C, CN, V]	➛ Identify 3-D objects in the environment that have parts similar to a 2-D shape.

Prior Knowledge

Students may have had experience

- sorting 3-D objects using a single attribute

Background Information

Sorting and classifying are basic concepts that help students organize and understand their surroundings. Through sorting and classifying experiences students come to understand that objects can be grouped in different ways. This supports part-part-whole understanding (e.g., 8 can be grouped as 7 and 1 or 5 and 3).

In order to sort, students need to identify attributes such as colour, shape or size. This is the basis of patterning.

Pierre van Hiele and Dieke van Hiele-Geldof, mathematics teachers from the Netherlands in the 1950s, researched the development of geometry thinking. Through their research they identified five sequential levels of geometric thought.

There are four characteristics of these levels of thought:

- The levels of geometric reasoning/understanding are sequential. Students must pass through all prior levels to arrive at any specific level.
- These levels are not age-dependent.
- Geometric instructional experiences have the greatest influence on advancement through the levels.
- Instruction or language at a higher level than the level of the student may inhibit learning.

Level 0 (sometimes labelled as Level 1): **Visual**

At this level students can name and recognize shapes by their appearance, but cannot specifically identify properties of shapes. Students may think that a rotated square is a "diamond" and not a “square” because it looks different from their visual image of square. Most students in Kindergarten to Grade 3 will be at Level 0 (visualization).

Suggestions for instruction at this level include:

- sorting, identifying, and describing shapes
- working with physical models
- seeing different sizes and orientations of the same shape in order to distinguish the characteristics of the shape and to identify features that are not relevant
- building, drawing, making, putting together, and taking apart 2-D shapes and 3-D objects.

Mathematical Language

colour words

student chosen vocabulary for shape (round, flat, pointy, like a box, like a can, etc.)

vocabulary for size (big, small, heavy, light, long, short, etc.)

sort

classify

group

the same as

different

2-D shape

3-D object

set

Learning Experiences

Assessing Prior Knowledge

Provide a variety of 3-D objects for each small group. Have the group sort the objects and then raise their hands. Talk with the group about their sorting rule. If it is a correct sort have them re-sort the collection in a different way. Continue in this manner until each group has sorted in several different ways.

Observation Checklist

Students are able to

- ❑ identify attributes for sorting (colour, size, shape)
- ❑ sort accurately into two or more groups
- ❑ explain the sorting rule

- **Sort a set of familiar 3-D objects or 2-D shapes using a given sorting rule.**
- **Sort a set of familiar 3-D objects using a single attribute determined by the student, and explain the sorting rule.**
- **Sort a set of 2-D shapes using a single attribute determined by the student, and explain the sorting rule.**
- **Determine the difference between two pre-sorted sets of familiar 3-D objects or 2-D shapes, and explain a possible sorting rule used to sort them**

- Read a book such as *The Button Box* by Margarette S. Reid to help to develop attribute language.
- Provide a collection of objects such as attribute (logic) blocks. Ask students to sort them by colour. Repeat sorting by size, by shape, and then by thickness.

  Note: Attribute blocks are 3-D objects because they have length, width, and thickness. They are, however, described using 2-D vocabulary (e.g.,  is described as a hexagon and not as a hexagonal prism). This is true for pattern blocks as well.

3-D objects refer to objects in the environment not specifically to the set of 3-D objects typically purchased as math materials.

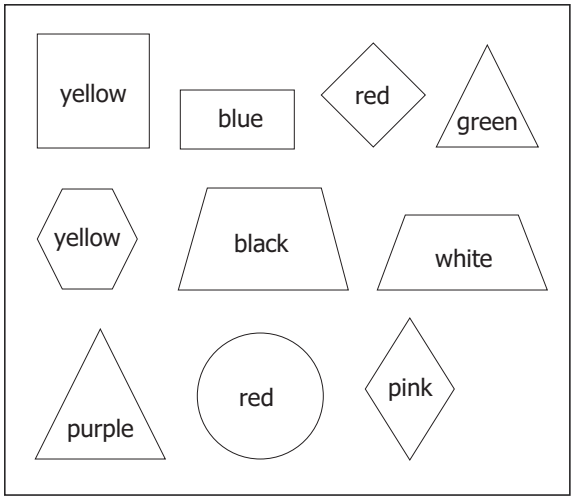
- Provide a collection of 3-D objects such as blocks, interlocking plastic building blocks, household food-stuff containers, buttons, etc. Have students sort them and then identify the sorting rule.

BLM
1.SS.4.1

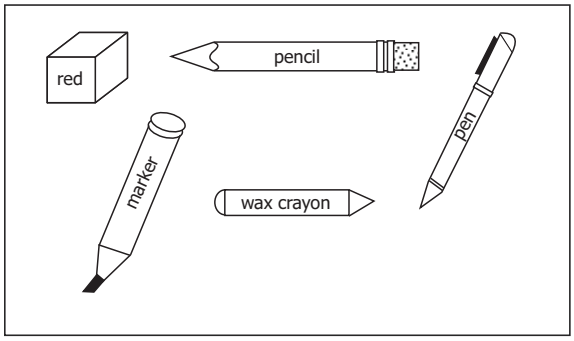
- Provide students with a collection of paper shapes of various sizes including triangles, rectangles, circles, and other shapes. Ask students to sort the collection into two groups and name the sorting rule. Then have students regroup the collection and sort it in other ways.
- Sort a collection of objects or shapes into two sets. Give students another object. Ask them to place it in one of the sets and explain why it belongs in that set.

  Note: The measurement outcomes provide many opportunities for sorting and classifying.
- Show students a set that contains an object or shape that does not belong. Ask the students to remove the object or shape that does not belong and explain why.
  - "Which shape/object does not belong? Why?"
  - "Find another shape/object that would belong to this set."

  Examples with shapes



  Examples with objects



Assessing Understanding

Give students a small group of 3-D objects.

1. Have them sort the objects and then state their sorting rule.
2. Ask them to re-sort the objects and then state their new sorting rule.
3. Sort a set of objects into two groups. Have students identify the sorting rule. Hold up another one of the sorted objects and ask them to identify where it should go.

Give students a small group of 2-D shapes.

1. Have them sort the shapes and then state their sorting rule.
2. Ask them to re-sort the shapes and then state their new sorting rule.
3. Sort a set of objects into two groups. Have students identify the sorting rule. Hold up another one of the sorted objects and ask them to identify where it should go.

Observation Checklist

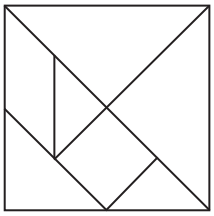
Students are able to

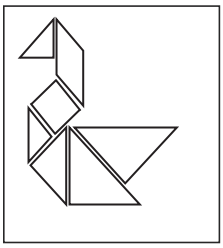
- ❑ sort a collection of 3-D objects using self-selected attribute(s)
- ❑ sort a collection of 2-D shapes using self-selected attribute(s)
- ❑ state the sorting rule of 3-D objects
- ❑ state the sorting rule of 2-D shapes
- ❑ re-sort a set of 3-D objects in another way
- ❑ re-sort a set of 2-D shapes in another way
- ❑ identify the sorting rule of a pre-sorted 3-D set
- ❑ identify the sorting rule of a pre-sorted 2-D set
- ❑ identify the placement of an additional 3-D object
- ❑ identify the placement of an additional 2-D shape

- **Select 2-D shapes from a given set of 2-D shapes to reproduce a composite 2-D shape.**
- **Predict and select the 2-D shapes used to produce a composite 2-D shape, and verify by deconstructing the composite shape.**

- Read a book such as *Tangram Magician* by Lisa Campbell Ernst or *Grandfather Tang's Story* by Ann Tompert. In each of these books tangram pieces (tans) are used to create composite 2-D pictures. (Note: Tans are labelled with 2-D names although they are actually 3-D objects.) Have students use a set of tangrams (commercial or paper) to create pictures.

BLM 1.SS.2& 3&4.1

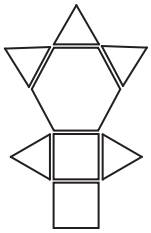




Templates for tangrams (such as the bird example) and pattern blocks can be purchased or found online. Students can directly match the shapes. Games, such as Tangoes, provide figures made from tangrams. Most are more challenging because the individual shapes are not marked.

- **Pattern Block Pictures:** Have students work with a partner. The first student makes a pattern block design with a specified number of pattern blocks. The second student selects the appropriate shapes and replicates the design. Students then reverse roles.

  Example:



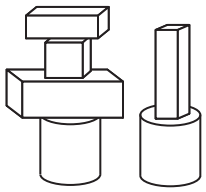
  Shapes can be traced, cut out, and glued down to record the design.

- **Shape Pictures:** Students make a picture using different-sized paper shapes, including circles, squares, rectangles, and triangles. As students are working, ask students to describe the shapes they are using. Students glue their pictures onto paper, add additional features, and describe their picture in sentences.

- **Select 3-D objects from a given set of 3-D objects to reproduce a composite 3-D object.**
- **Predict and select the 3-D objects used to produce a composite 3-D object, and verify by deconstructing the composite object.**

- **Copy Me!:** Build a composite 3-D object. Have students select the appropriate 3-D objects and reproduce the composite.

  Example:



- **Behind the Wall:** Work in partners. Set up a screen between students or have partners sit back-to-back. Have one student create a composite 3-D object using a specified number of objects and then describe it to his or her partner. The partner uses the description to reproduce the composite object. They then lift the barrier to check. Make note of the vocabulary students are using.

- Use the overhead projector and a set of attribute or pattern blocks.

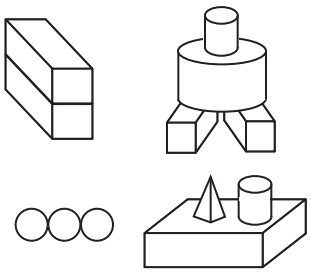
  a) Place a shape on the overhead. Have students match the shadow to a shape in their collection.

  b) Show shapes partially covered and ask students to predict the shape by selecting one from their collection. Have students justify their predictions.

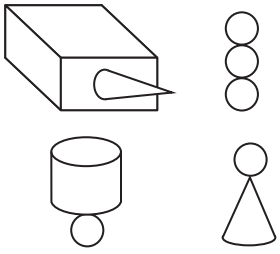
- Provide a set of pictures of composite objects that are possible or impossible to build. Ask students to sort the pictures and to justify their choices. Then ask students to build the possible composite objects using the solids shown in the pictures.

  Examples:

Possible



Impossible



Assessing Understanding

Give students a small group of 3-D objects.

1. Give students a composite 2-D shape and have them reproduce it.
2. Give students a composite 3-D shape and have them reproduce it.

Observation Checklist

Students are able to

- ❑ reproduce a composite 2-D shape
- ❑ reproduce a composite 3-D object
- ❑ predict and select the 2-D shapes used to create a 2-D composite shape
- ❑ predict and select the 3-D objects used to create a 3-D composite object
- ❑ verify their predictions by decomposing the composite shape/object

- **Identify 3-D objects in the environment that have parts similar to a 2-D shape.**

- Read a book such as *Cubes, Cones, Cylinders & Spheres* by Tana Hoban. The pictures show everyday objects that resemble cubes, cones, cylinders, and spheres.
- **Shape Hunt**

  Materials:

  - cards (each with a different 2-D shape)
  - a wide variety of 3-D objects (classroom objects, food-stuff containers, and small boxes, etc.)

  Directions:

  Students work in small groups. Each group draws a 2-D shape card and then hunts for 3-D objects that have parts similar to their shape. Groups can either gather the actual objects or record their findings in pictures and words. A digital camera could also be used to take pictures of the objects (Literacy with ICT connection). Have groups share their findings with the class. Ask questions such as

  - Did any groups find/record the same objects? How is this possible?
  - Are some shapes easier to find? More difficult to find?

- **Social Studies Connection:** The *Connecting and Belonging: A Foundation for Implementation* (2005) document suggests the following activity:

  "Post pictures of significant places and landmarks in the local community. Each day, provide clues about one of the pictures, describing its relative position in the community (e.g., I am thinking about a landmark on the grass; I am thinking about a landmark in the park…). Students guess the landmark being described and, once it is identified, describe its relative position."

  Extend the activity by having students use measurement and geometric terms to describe the significant places and landmarks.

- **Mystery Bag:** Students work with a partner or in small groups.

  Materials:

  - a different 3-D composite object for each student
  - a collection of 3-D objects needed to reproduce the composite objects
  - a bag large enough to hold the collection of 3-D objects

  Directions:

  Student A reaches into the bag and selects a 3-D object that he or she thinks is needed in order to reproduce a 3-D composite object. If correct he or she keeps the object, if not, the object is returned into the bag. Student B then takes a turn. Play continues in this manner until a student has reproduced a composite 3-D object.

  Note: This activity can be done with 2-D composites shapes.

Assessing Understanding

Journal/Learning Log: Have students select two 2-D shapes and identify in words and/or pictures three or four objects in the environment that have parts similar to their 2-D shapes.

Problem Solving: I traced around one of the faces/sides of an object in the classroom.

This is the shape it made: ○

What object could I have used?

Performance Task: Design Challenge

Materials:

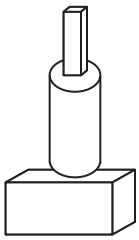
- a collection of 3-D objects such as food-stuff containers, classroom objects, blocks, etc.
- large sheets of mural paper or tag/bristol board
- markers

Directions:

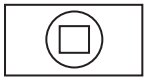
Have students work in small groups.

Tell students that they have been asked to design and make a model community. They are going to build it on the large piece of mural paper using the classroom collection of 3-D objects. Once the community has been designed the group is going to take the structures apart. (**Note:** If possible take a picture of the community for later comparison.) As they do this they are going to record the objects used by tracing the face of each object used.

Example



This structure would be recorded as:



Once complete, groups trade places and try to reconstruct the community by following the 2-D shape diagrams.

Have the original groups assess the success of the reconstruction.

Assessing Understanding

Listen to the language used as they build, record, and reconstruct their communities.

Observation Checklist:

Students are able to

- ❑ identify the 3-D object using the 2-D face
- ❑ reconstruct a composite 3-D object from the drawings