



KINDERGARTEN MATHEMATICS

Shape and Space

Kindergarten: Shape and Space (Measurement) (K.SS.1)

Enduring Understanding: Objects can be compared using the same attribute.

Essential Question(s): How can objects be compared?

SPECIFIC LEARNING OUTCOME(S):	ACHIEVEMENT INDICATORS:
<p>K.SS.1 Use direct comparison to compare two objects based on a single attribute, such as length (height), mass (weight), and volume (capacity). [C, CN, PS, R, V]</p>	<ul style="list-style-type: none">→ Compare the length (height) of two objects, and explain the comparison using the words “shorter,” “longer (taller),” or “almost the same.”→ Compare the mass (weight) of two objects, and explain the comparison using the words “lighter,” “heavier,” or “almost the same.”→ Compare the volume (capacity) of two objects, and explain the comparison using the words “less,” “more,” “bigger,” “smaller,” or “almost the same.”

PRIOR KNOWLEDGE

Students may have had no formal experiences with these concepts.

BACKGROUND INFORMATION

During free and directed play, students discover the properties of materials and develop an awareness of the specific attributes of measurement. Students, at this age, use language in keeping with their understanding, such that big can mean long, heavy, holds more, and so on. As they have more experience with comparisons, and as they hear a teacher model language more specific to the attributes of materials, students replace big with appropriate terms.

TEACHER KNOWLEDGE

Mass is a measure of how much matter there is in an object. It can be measured using a pan balance and standard masses. The mass of an object is measured in grams and kilograms.

The word “weight” is a measure comprised of a combination of the mass of an object and the pull of gravity on that mass. It can be measured using a spring balance. Weight is frequently used when mass is intended. Weight is measured in Newtons.

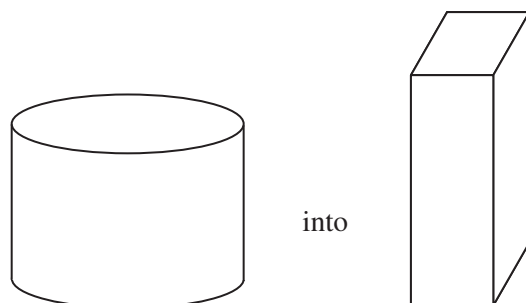
Note: Students may assume that large objects are automatically heavier and small objects lighter. They need to have opportunities to pick and compare containers of different sizes, shapes, and weights.

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

“Capacity” is the amount a container is able to hold.

Note: When pouring from one container to another a student may believe that the second container holds more if the level appears higher even if they pour the contents back into the first container.

Example:



This is because the child is not yet conserving the capacity of the container or the volume of the material in it.

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 a student fills a glass to the brim with milk, he or she is 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.)

MATHEMATICAL LANGUAGE

Longer, shorter, taller, almost the same, lighter, heavier, less, more, bigger, smaller, length, height, full, empty, compare



Assessing Prior Knowledge

Brainstorm with the class things that are long or short, heavy or light, full or empty. This will help to determine their understanding of the vocabulary.

- **Compare the length (height) of two objects, and explain the comparison using the words “shorter,” “longer (taller),” or “almost the same.”**

- Provide students with objects of different length or height. Model the language of comparison, then have students compare objects using these words:
 - long/short
 - tall/short
 - almost the same

Note: Focus their attention on the need for a common starting point. Show them how to line up the two objects so that they start from a common point.

- **Socks:** Gather a collection of adult socks – one pair of long socks, one pair of medium length, and one pair of short socks. Hold up the long socks. Choose a student to put them on over his or her own socks. Ask students to describe how they fit (e.g., “They are really long. They go all the way past his or her knees.”).

Show the short socks. Have another student put them on. Ask students to describe how they fit (e.g., “They are really short. They only go up to her or his ankle.”).

Now, show the medium length socks. Ask, “Are these socks short or long?” Have a student put them on. Compare this student with the student in the long socks then compare with the short socks.

Encourage students to look at their own socks and compare them with the adult socks.

- **How Do We Compare?:** Put students in pairs. Have the pairs take turns standing back-to-back while the other groups use the terms; taller than, shorter than, or almost the same, to compare their heights.

- **Size Detective:** Play with the whole class or a small group.
Materials: overhead projector, objects
Directions: Place a pencil on the overhead. Ask students to look for something that is longer/shorter than the pencil. Place their objects on the overhead to compare. Continue with other objects.
Ask students to make collections of objects that are similar, shorter, or longer in length.
- Supply craft supplies so students can make objects of specific lengths, such as, as long as your foot, as short as their thumb, and the same length as this paper.
- Ask students to use unifix cubes to make trains that are longer than, shorter than, and the same length as a given object.
- Provide class with strips of ribbon and one stick approximately 30 cm long. Have students sort ribbons into three groups: shorter than, longer than, and the same length as the stick.



Assessing Understanding: Performance Task

Block Towers: Have students work with a partner at the block centre. Ask them to choose five blocks and to build the tallest tower they can. As they work ask the following questions:

- “How many blocks did you use for your tower?”
- “How did you decide what blocks to use?”
- “Is this the tallest tower you can build?”
- “Can you build a different tower using 5 blocks?”
- “Is the new tower taller or shorter than the first one? How do you know?”
- “Is there anything you can do to make one of your towers taller? Shorter?”

Observation Checklist

Students are able to

- construct a tower with five blocks
- justify the choice of blocks
- make a different tower
- identify whether the second tower is taller or shorter than the first
- use the language of comparison correctly
- suggest ways to make the tower taller or shorter

■ **Compare the mass (weight) of two objects, and explain the comparison using the words “lighter,” “heavier,” or “almost the same.”**

- Read a book such as *Mighty Maddie* a MathStart book by Stuart J. Murphy as an introduction to the comparative vocabulary for mass (light, lighter, heavy, heavier).
- Ask students to compare the masses of objects using just their hands. Model the language of comparison. For example:
 - The book is heavier than the unifix cube.
 - The ball is lighter than the book.

- **Balancing Act:** Provide free exploration time for students to experiment with a pan/equal arm balance and a variety of objects. Have them record their observations. Have them share their findings with the class. Note: Some students may not realize that the pan/side that goes down holds the heavier object. Ask focus questions such as

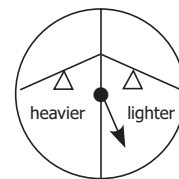
- How do you know which object is heavier?
- How do you know which object is lighter?
- What can you tell me about these two objects?
(e.g., A is lighter/heavier than B.)



- **Making Predictions:** Have students stand with their arms outstretched to simulate a pan balance. The teacher holds a heavier object in their right hand and a lighter one in their left. Ask students to show what they think will happen on the pan balance. Confirm their predictions by using the pan balance. Repeat this activity with other objects.

- **Problem Solving:** Students work in partners. Give each group a small box or bag and three or four objects, each of different mass. Let students become familiar with the objects then place them in another container or under a cover. Have the first student secretly place one of the objects in the box/bag. Have the second student guess which object was chosen by handling the box/bag. Have them justify their choice using related vocabulary. Reverse roles and play again.

- **Who’s Bag Is Heavier?:** Have students work in pairs with a screen between them. Provide each student with a collection of classroom objects and a bag. Each pair will also need a heavier/ lighter spinner. Student A rolls the dice and calls out the number rolled. Both students, independently, place a corresponding number of objects in their bags. Student A spins the spinner. They then compare their bags to determine the heaviest/lightest. The student with the heaviest/lightest bag gets a counter or scores a point. Play continues until one player scores five points. As students play ask questions such as



BLM
K.SS.1.1

- How did you decide what objects to put in your bag?
- How can you change the weight of your bag?
- How did you test to see who had the heaviest/lightest bag?



Assessing Understanding: Paper-and-Pencil Task

Set up four stations. Place two objects, each of different mass, at three of the stations. Place two objects of similar mass at one of the stations. Have students rotate through the stations comparing the objects and recording their findings with pictures (words if applicable).

- **Compare the volume (capacity) of two objects, and explain the comparison using the words “less,” “more,” “bigger,” “smaller,” or “almost the same.”**

- **Exploring Volume (capacity):** Students should develop an understanding of volume (capacity) through free and directed play. Possible activities include
 - filling a variety of containers. Provide several kinds of containers (bottles, cans, jugs, cups, cartons). There should be containers with different shapes but equal capacities, and containers that will “nest” so that they have an obvious ordered relationship.
 - filling containers with various materials such as sand, water, rice, beans, small math materials (unifix, counters, centimetre cubes, buttons)
 - filling one container and then pouring it into another container

- **More, Less, or Almost the Same:** Ask students to find something that will hold “more than,” “less than,” or “almost the same as” a given container. Ask questions such as:
 - How can you tell if your container holds more than, less than, or almost the same as the first container?
 - If you filled the containers with something else would your container still hold more than, less than, or almost the same as the first container?

- **Pack and Unpack:** Have students pack and unpack classroom objects such as math materials, toys, books, or games to develop a sense of what will and will not fit.

- **Real-World Connections:** Brainstorm a list of situations where you might be filling or packing. For example:
 - filling the bathtub
 - filling a cup or glass with drink
 - filling a bowl with cereal
 - packing groceries
 - packing a suitcase

- **Science Connection:** Connect to the Paper cluster in science. Have students follow the design process to construct an object to hold a certain volume.



Observation Checklist

Students are able to

- use the terms less, more, bigger, smaller, or almost the same to compare the volume of two objects
- find a container that holds more than a given container
- find a container that holds less than a given container
- find a container that holds almost the same as a given container

Integrating Measurement into Kindergarten Routines and Centres

CENTRE	SUGGESTED ACTIVITIES
Arts and Crafts	Making playdough objects that are long, short, or the same length. Make a picture with objects of different lengths.
Sand and Water	Filling and pouring sand and water. Making sandcastles with different sized containers. Estimating and then checking to see how many smaller containers it takes to fill a larger container; how many smaller containers can be filled by a larger container.
Block/Construction	Make towers/buildings of different heights. Packing blocks into different sized containers. Sorting blocks into categories such as long or short, heavy or light.
Theme	Ordering stuffed animals, toys, food stuff, etc., by length or mass (weight). Comparing objects using a pan/equal arm balance. Comparing containers (teacups, pots, etc.) by volume (capacity).
Science	Compare leaves and/or pictures of trees. Sort according to length/height. Explore different types of paper to determine the best material to use to hold various objects (volume/capacity and mass/weight).

PUTTING THE PIECES TOGETHER



Investigation: Compare Stations

1. Set up a table with six “compare” stations – two stations each of mass (weight), length, and volume (capacity). Have students compare objects at each station, explaining the comparisons. As students become confident in the measurement process, have children record the results of the comparisons.

Observation Comments

BLM
K.SS.1.2

Student	Mass (weight)	Length	Volume (capacity)

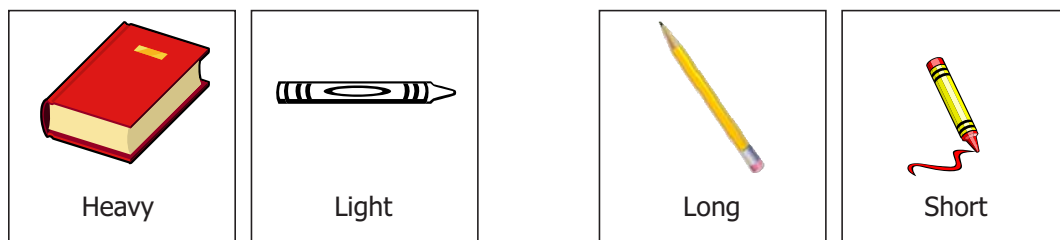
What to look for

- Do students understand the concept of mass, length, or volume?
 - Do they have an effective strategy for doing the comparisons?
(Example: measure from a common starting point; use hands or a balance scale; fill or pack)
 - Do they confidently use the comparative vocabulary related to the particular concept?
2. Class measurement book

Have students work in pairs or small groups. Assign each group to a measurement topic or to specific vocabulary.

Use a digital camera (Literacy with ICT connection) or have students draw pictures to illustrate the book.

Example:



Kindergarten: Shape and Space

(3-D Objects and 2-D Shapes) (K.SS.2, K.SS.3)

Enduring Understanding: Objects can be sorted by similarities.

Shapes can be described and compared using their attributes.

Essential Question(s): How are the objects alike?

In which ways can the objects be sorted?

What is the sorting rule?

How can 3-D objects be described?

SPECIFIC LEARNING OUTCOME(S):	ACHIEVEMENT INDICATORS:
<p>K.SS.2 Sort 3-D objects using a single attribute. [C, CN, PS, R, V]</p>	<ul style="list-style-type: none">→ Sort a set of familiar 3-D objects using a single attribute, such as size or shape, and explain the sorting rule.→ Determine the difference between two pre-sorted sets by explaining a sorting rule used to sort them.
<p>K.SS.3 Build and describe 3-D objects. [CN, PS, V]</p>	<ul style="list-style-type: none">→ Create a representation of a 3-D object using materials such as modelling clay and building blocks, and compare the representation to the original 3-D object.→ Describe a 3-D object, using words such as “big,” “little,” “round,” “like a box,” and “like a can.”

PRIOR KNOWLEDGE

Students may have had no formal instruction with these concepts.

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.

Note: Support sorting by providing defined areas for grouping (e.g., paper plates or yarn circles).

MATHEMATICAL LANGUAGE

Sorting: Colour words, informal 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

3-D Objects: big, little, round, “like a box”, “like a can”, ball, flat, etc.

LEARNING EXPERIENCES



Assessing Prior Knowledge

Give students a small collection of objects that can be sorted by one attribute (e.g., unifix cubes that can only be sorted by colour). Ask them to sort them or to put them into groups. Ask them to explain their sorting rule.

If successful, give them a small number of pattern blocks and have them sort them. Ask them to explain their sorting rule.

Observation Checklist

Students are able to

- sort objects by colour
- sort objects by shape
- explain their sorting rule

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

- **Sort a set of familiar 3-D objects using a single attribute, such as size or shape, and explain the sorting rule.**
- **Determine the difference between two pre-sorted sets by explaining a sorting rule used to sort them.**

- Students should have many sorting and classifying experiences using a wide variety of objects.
- **What's My Rule?:** Sort a set of attribute (logic) blocks into two groups. Have students guess your sorting rule. Select a student to resort the objects. Have students guess their sorting rule.
- **Student Sort:** Sort students in different ways and have students guess the rule (e.g., boys/girls; wearing jeans/not wearing jeans; dark hair/not dark hair; wearing red/not wearing red; etc.).
- **Where Does It Belong?:** Sort a set of objects into two groups leaving some objects out of the sort. Hold up one of the objects and ask students to identify where it belongs. Have students justify their choice.

Attribute blocks can be sorted by colour, shape, size, and thickness.

Note: Students at this level may not be ready to sort by thickness.

Note: Connect sorting to the measurement activities.



Assessing Understanding

Give students a small group of attribute blocks.

1. Have them sort them and then state their sorting rule.
2. Ask them to re-sort the set 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 objects using one attribute
- state the sorting rule
- re-sort a set of objects in another way
- identify the sorting rule of a pre-sorted set
- identify the placement of an additional object

- **Create a representation of a 3-D object using materials such as modelling clay and building blocks, and compare the representation to the original 3-D object.**
- **Describe a 3-D object using words such as “big,” “little,” “round,” “like a box,” and “like a can.”**

- Gather a collection of small 3-D objects from the classroom. Have students select one of the objects and make a model of it using playdough or plasticine. Have them compare their model with the actual object. Ask, “Is your model the same as the object? How do you know?”

Although students are using informal vocabulary, teachers should model correct terminology.

Mix up the original objects and the student models.

Have students see if they can match the models to the original objects.

- Have students bring in a collection of ‘food stuff’ containers. Use this collection for sorting, building with, and exploring 3-D objects. **Note:** The containers can also be used for some of the measurement activities.
- Show students a group of objects – cans, cones, balls, boxes, etc. Have them sorted into groups. Ask students to describe the objects in each group.
- **I Spy:** Give students a clue to a particular 3-D object in the classroom and have them guess which object you have selected (e.g., “I spy with my little eye something that is like _____.”). Hold up an object. Are students guessing objects that are similar in shape?

Integrating Measurement into Kindergarten Routines and Centres

CENTRE	SUGGESTED ACTIVITIES
Arts and Crafts	The creation of 3-D structures can be expressed by providing students with a rich variety of paper, writing tools, plasticine/playdough, paper rolls, and similar craft items. Draw pictures of various 3-D objects and constructions.
Sand	Build sandcastles and different shape patterns in the sand.
Block/Construction	Have both commercial and non-commercial objects for building and constructing. Sorting blocks by shape.
House/Theme	Use food stuff containers.
Technology	Use drawing software to make shapes and pictures.

POSITIONAL LANGUAGE

Although there are no specific outcomes related to positional language in the curriculum it is important for students to develop these skills.

At this level, students describe the world in relation to themselves. Because of this egocentricity, positional language should be developed, beginning with comparison of self to others and of self to objects. Proceed to make comparisons of objects to self, and then object to object.

LEARNING EXPERIENCES

- Model positional language in everyday activities – lining up, finding things, calendar work, gym activities . . .
- Use objects to explore and foster student understanding of positional language: “The car is in front of that truck. Now Joel is driving it over the bridge . . .”
- **Play *Simon Says*:**
 - “Simon says stand outside our circle but beside the teacher’s desk.”
 - “Simon says step over the triangle.”
 - “Simon says put the pencil between the two crayons.”
- Have a student take a teddy bear and position it so it is visible to the group. Ask other students to describe where the bear is.
Examples: “The bear is between the bookshelf and the chair.” “It is under the ceiling.”
- **Play *Twenty Questions*:** Use cubes to count the number of questions students ask to identify an object.
Example:
Teacher says “I am thinking of an object on our bulletin board.” Students ask, “Is it over the _____?” (Students will likely need modelling of the types of Yes/No questions expected.)

PUTTING THE PIECES TOGETHER



Investigation: Kindergarten Town/City

Materials: classroom objects
food stuff containers, paper rolls
playdough, plasticine
scissors, glue, paper, tape, etc.

Tell students that they are going to design/make a model of a Kindergarten Town/City. Brainstorm buildings and structures they would like to have in their town or city.

Have students work in small groups. Designate a specific area in the classroom for each group. A large piece of cardboard or tag can be used to define the dimensions of the construction.

As students are working, talk to them about their constructions and particular 3-D objects.

Have each group present their constructions. Ask them to take turns describing the 3-D objects used. Encourage the use of measurement vocabulary as well, especially vocabulary related to length/height.



Observation Checklist

Students are able to

- identify objects used in the construction
- describe an object using informal (formal) vocabulary