GRADE 2 MATHEMATICS

Shape and Space

Grade 2: Shape and Space (Measurement) (2.SS.1)

Enduring Understanding:

Events are ordered.

Essential Question:

How can the order of events be described?

SPECIFIC LEARNING OUTCOME(S):	ACHIEVEMENT INDICATORS:
2.SS.1 Relate the number of days to a week and the number of months to a year in a problem-solving context. [C, CN, PS, R]	➤ Read a date on a calendar. ➤ Name and order the days of the week. ➤ Identify the day of the week and the month of the year for an identified calendar date. ➤ State that there are seven days in a week and twelve months in a year. ➤ Determine whether a set of days is more or less than a week. ➤ Identify yesterday's/tomorrow's date. ➤ Identify the month that comes before and the month that comes after a given month. ➤ Name and order the months of the year. ➤ Solve a problem involving time that is limited to the number of days in a week and the number of months in a year.

PRIOR KNOWLEDGE

Students may not have had any formal instruction with these concepts.

BACKGROUND INFORMATION

In the real world the calendar is used to plan, keep track of appointments, and measure time. This is how it should be used in the classroom.

Build the calendar at the beginning of the month so that the focus is on the structure of the month and numerical patterns. If possible, have a one page, year-long calendar nearby. Write birthdays and special events on the calendar.

MATHEMATICAL LANGUAGE

Monday	January	September
Tuesday	February	October
Wednesday	March	November
Thursday	April	December
Friday	May	month
Saturday	June	year
Sunday	July	week
	August	

LEARNING EXPERIENCES

Assessing Prior Knowledge

Ask students to

- identify today's date on the calendar
- identify the day of the week
- identify the month
- read the date
- give the month and date of their birthday

Observation Checklist

Use a checklist for recording purposes.

- **Read a date on a calendar.**
- **Identify the day of the week and the month of the year for an identified calendar date.**
- **Identify yesterday's/tomorrow's date.**

Suggestions for Instruction

- **Through the Year:** Use a year-long calendar as a game board. Begin on January 1st. Student A rolls a dice, moves the number of spaces indicated and reads the date landed on (e.g., Saturday, January 13th). Play continues until a player reaches December 31st.

- **Calendar Routine:** Assign two students each day to the calendar routine.

  Job description:

  1. Write today's date and be prepared to give the dates for yesterday and tomorrow.

  2. Highlight any special events listed for today.

  3. Locate today's date on the year-long calendar.

  4. Choose two calendar questions (listed below) and answer them.

  5. Be prepared to share your information with the class.

  Calendar questions:

  - Is the third Wednesday an even or an odd number?
  - Is the first Thursday an even or an odd number?
  - Write the date of the second Friday.
  - On which day of the week is the first two-digit number?
  - On which day of the week is the last one-digit number?
  - On which day of the week is the 14th?
  - On which day of the week is the ninth?
  - Which day of the week is seven days after the 14th?
  - Which day of the week was five days before the 22nd?
  - How many full weeks are in this month?
  - How many partial weeks are in this month?
  - Find the shortest week this month.
  - What season will it be four months from today?
  - What season will it be nine months from today?
  - Which day of the week is nine days after the sixth?
  - Find the second week. What is Friday's date?

- How many more months until June?
- How many more months until September?
- How many more months until November?
- How many more months until May?
- How many more months until Christmas?
- If your birthday were in this month, on which day would it fall?
- Find the third week. What is the first date and last date of this week?
- Find the last week. What is the first date and last date of this week?
- On which day of the week does the first two-digit odd number fall?
- On which day of the week is the 25th?
- On which day of the week is the 16th?
- In four months, what month will it be?
- In nine months, what month will it be?
- In 12 months, what month will it be?
- On which day of the week is the first two-digit even number?
- On which day of the week is the 12th?
- How many Saturdays are there in this month?
- Write the date of the second Wednesday.
- Write the date of the last Monday.
- Write the date of the first Thursday.
- In six months, what month will it be?
- If you had homework every Monday this month, how many times would you have had homework?
- What day of the week comes after the 15th?
- What day of the week comes before the 26th?
- What day of the week comes before the 4th?
- What day of the week comes before the 17th?
- What is the last day of the month?
- What month comes after this one?
- What month came before this one?
- What day of the week is four days after the 19th?
- What day of the week is two days before the 20th?
- What day of the week is seven days after the 13th?
- On which day of the week will the first day of the next month fall?
- On what day of the week does the third Saturday fall?

- What day of the week is three days before the 11th?
- How many Thursdays are in this month?
- On what day of the week does the 10th fall?
- How many days are in the last week of this month?
- How many Fridays are there in this month?
- What is the date of the second Monday?
- How many days are in this month?
- How many school days are in this month?
- This month falls in which season?

- **Name and order the days of the week.**
- **Determine whether a set of days is more or less than a week.**

Suggestions for Instruction

- Read a book such as *Today is Monday* by Eric Carle to introduce or reinforce the order of the days of the week.

- Use songs and poems to help students remember the days of the week.

  Example:

  Use the tune to "Clementine."

  > There are seven days
  > There are seven days
  > There are seven days in a week.
  > Sunday, Monday,
  > Tuesday, Wednesday,
  > Thursday, Friday,
  > Sa-tur-day.

- **What's Missing?** Write the days of the week on cards and put them in order in a pocket chart. Read them together. Have students close their eyes. Remove one of the cards. Have students open their eyes and identify the missing day.

  Extension: Remove two cards each time.

■ **Build-a-Week Game:** Students play in groups of two to four to place the days of the week in order to complete a week.

Materials:

game board
game cards (four of each of the days of the week)

Note: Enlarge the games to fit an 11 x 17 sheet.

Directions:

Shuffle the game cards and place them face down on the game board. Student A draws a card and places it in the correct space on their side of the board. If they are unable to use the card they lose a turn and the card is returned to the bottom of the pile. Play continues until one player has completed the week.

Build a Week

Game Cards
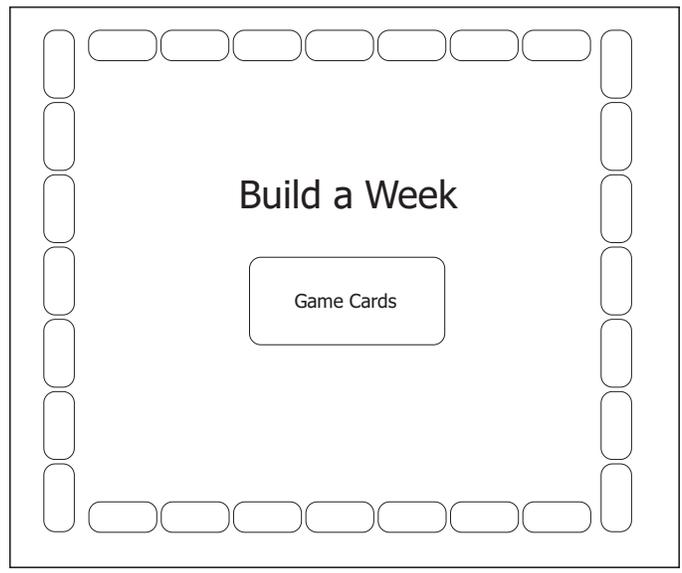
Assessing Understanding: Interview

Have students order cards with the days of the week written on them.

Observation Checklist

Observe students as they do the calendar routine or play the Build-a-Week game.

- **Name and order the months of the year.**
- **Identify the month that comes before and the month that comes after a given month.**

Suggestions for Instruction

- Use songs and poems to help students remember the months of the year.

  Example:

  Use the tune to "One Little, Two Little ...."

  > January (one little)
  > February (two little)
  > March and (three little)
  > April (…)
  > May (four little)
  > June (five little)
  > July and (six little)
  > August (…)
  > September (seven little)
  > October (eight little)
  > November (nine little)
  > December (ten little)
  > 12 months in a year (Ten little …)

  Note: There is no expectation that students write out or spell the days of the week or months of the year by memory in this outcome.

BLM
2.SS.1.3

- **What's the Order?** Prepare a set of tent cards with the months of the year written on them. Use a clothesline. Place January, June, and December on the line as referents. Have students take turns drawing a card, placing it on the clothesline and justifying the placement.

  January
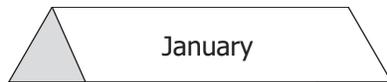
- Read a book such as *Pepper's Journal: A Kitten's First Year* by Stuart J. Murphy. In this story the girl keeps a journal describing the changes in a kitten over a year. The book supports an understanding of the relationships among days, weeks, months, and years. It also shows the practical (real world) use of the calendar.

- Provide students with individual calendars and encourage them to focus on the number of months in the year. For example, ask students to write in the dates of special events, such as field trips, classmates' and family birthdays, and school holidays. If the class has been counting the days at school for Hundred Day, students may want to include this information as well.

- **Missing Months Game:** Use an open-ended game board. Prepare a set of cards.

Example:

| February, _____, April | | _____, October, November |

Players take turns drawing a card and filling in the missing month. If correct, they roll a dice and move the number of spaces shown.

Assessing Understanding: Interview

Have students order cards with the months of the year written on them.

Observation Checklist

Observe students as they do the calendar routine or play the Missing Months game.

- **State that there are seven days in a week and twelve months in a year.**
- **Solve a problem involving time that is limited to the number of days in a week and the number of months in a year.**

Suggestions for Instruction

- **Connect to Statistics:** Have students do a survey to determine the favourite day of the week or month of the year. Make a pictograph of the class birthdays.

- Present students with problems such as the following:

    1. Bill's birthday is in September. Maria's birthday is two months after Bill's. Paul's birthday is three months before Bill's. In what month is Maria's birthday? Paul's birthday?

    2. Name the seventh month. Who has a birthday in the third month? Which months are in the middle of the year? What month is between October and December?

    3. Jason is going on a trip in two weeks. How many more days does he have to wait?

    4. Kate's little sister is two years old. How many months old is she?

    5. Anna walks her dog twice each day. How many times does she walk the dog in a week? in two weeks?

Keeping Records

Organization:

> whole class

Materials:

> calendar with spaces large enough to record events or pictures

Context:

Tell students that the class is going to keep a record of the events (birthdays, special lunch days, field trips, visitors, holidays, etc.) that happen over the course of the school year.

The calendar can be arranged in a timeline form or made into a class journal. Individual or pairs of students can take turns being responsible for recording and writing about events. Pictures can also be included.

Notes

Grade 2: Shape and Space (Measurement) (2.SS.2, 2.SS.3, 2.SS.4, S.SS.5)

Enduring Understandings:

Objects have distinct attributes that can be measured with appropriate tools.
Objects can be compared using the same attribute.
Changing the position of an object does not affect its attributes.

Essential Questions:

Why are units used in measuring?
How are non-standard units used to measure objects?
How are measuring units selected?
How is estimation helpful in measurement?
How do measurements help compare objects?

SPECIFIC LEARNING OUTCOME(S):	ACHIEVEMENT INDICATORS:
2.SS.2 Relate the size of a unit of measure to the number of units (limited to non-standard units) used to measure length and mass (weight). [C, CN, ME, R, V]	➛ Explain why one of two non-standard units may be a better choice for measuring the length of an object. ➛ Explain why one of two non-standard units may be a better choice for measuring the mass of an object. ➛ Select a non-standard unit for measuring the length or mass of an object, and explain why it was chosen. ➛ Estimate the number of non-standard units needed for a measurement task. ➛ Explain why the number of units of a measurement will vary depending upon the unit of measure used.
2.SS.3 Compare and order objects by length, height, distance around, and mass (weight) using non-standard units, and make statements of comparison. [C, CN, ME, R, V]	➛ Estimate, measure, and record the length, height, distance around, or mass (weight) of an object using non-standard units. ➛ Compare and order the measure of two or more objects in ascending or descending order, and explain the method of ordering.

(continued)

SPECIFIC LEARNING OUTCOME(S):	ACHIEVEMENT INDICATORS:
2.SS.4 Measure length to the nearest non-standard unit by ■ using multiple copies of a unit ■ using a single copy of a unit (iteration process) [C, ME, R, V]	➤ Explain why overlapping or leaving gaps does not result in accurate measures. ➤ Count the number of non-standard units required to measure the length of an object using a single copy or multiple copies of the same unit of measure. ➤ Estimate and measure an object using multiple copies of a non-standard unit and using a single copy of the same unit many times, and explain the results. ➤ Estimate and measure, using non-standard units, a length that is not a straight line. ➤ Create different rulers, using non-standard units of measure, and use these rulers to measure length.
2.SS.5 Demonstrate that changing the orientation of an object does not alter the measurements of its attributes. [C, R, V]	➤ Measure an object, change the orientation, re-measure, and explain the results.

PRIOR KNOWLEDGE

Students may have had experience looking at measurement as a process of comparing by

■ identifying attributes that can be compared

■ ordering objects

■ making statements of comparison

■ filling, covering, or matching

Background Information

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.

Weight is a measure comprising a combination of the mass of an object and the pull of gravity on that mass. Weight is measured in newtons. In daily life, the terms *mass* and *weight* are virtually interchangeable, but in reality they are not the same. *Weight* is frequently used when *mass* is intended.

The use of non-standard units allows students the opportunity to develop an understanding of measurement.

Iteration means the act of repeating. In measurement, using a unit smaller than the object being measured and repeating it end-to-end is an example of iteration.

Referent is a known quantity used to estimate or compare (e.g., using the width of the baby finger as a referent for a centimetre).

Mathematical Language

length	lighter than	estimate
mass	unit	non-standard
weight	measurement	ruler
longer than	height	tall
shorter than	compare	short
heavier than	distance around	

Assessing Prior Knowledge

Set up a measurement centre. Provide a collection of objects each with a different length and mass. Have students choose two objects and compare their length and mass. Record their findings using comparative statements.

Observation Checklist

The student is able to

❏ compare the objects by length

❏ compare the objects by mass

❏ write (or state orally if necessary) comparative statements about their findings

❏ use the language of measurement and comparison

- **Explain why one of two non-standard units may be a better choice for measuring the length/mass of an object.**
- **Select a non-standard unit for measuring the length or mass of an object, and explain why it was chosen.**
- **Explain why the number of units of a measurement will vary depending upon the unit of measure used.**

Suggestions for Instruction

Collect a variety of non-standard measurement tools such as craft sticks, paper clips (large and small if possible), bear counters (three sizes), toothpicks, straws, unifix cubes, colour tiles, pennies, blocks, et cetera.

- **Comparing Units:** Students work in small groups. Provide each group with a different non-standard unit (small paper clips, craft sticks, straws, bear counters [one size], toothpicks). Have students use the unit to measure the length of their table or a desk. Record their results. Debrief the activity with the whole class. Have each group present their findings. Ask questions such as

  - Did any group have problems using their measuring unit? (Perhaps a group with a very small unit such as a paper clip might have difficulty handling them or keeping them in a row.)

  - Did you find your measuring unit easy to use? Why?

  - Each group measured the same object. Why did groups get a different answer?

  - Does the size of the measuring unit make a difference?

  - Do you think that the size of the measuring unit would make a difference if you were finding the mass of an object?

  Repeat the activity for mass to investigate students' predictions. Use non-standard units (small paper chips, craft sticks, straws, counters, toothpicks, etc.) to measure the mass of small objects in the classroom (blocks, counters, pencils, erasers, etc.).

- At this level, students need a lot of practice making and accepting estimates. Estimates are not random guesses, nor are they exact predictions. This learning is ongoing. Model the use of referents at all times (e.g., placing one paper clip beside the pencil or one rod beside the string before estimating).

- Select a variety of objects of different lengths. Have students determine the best (most efficient) non-standard measurement unit to use and justify their choice.

  Repeat the activity for mass.

Assessing Understanding: Journal Entry

Mark and Elly measured the length of the teacher's desk.

I got an answer of 45 units.

I got an answer of 15 units.

Mark

Elly

Explain how this might have happened.

- **Estimate, measure, and record the length, height, distance around, or mass (weight) of an object using non-standard units.**
- **Compare and order the measure of two or more objects in ascending or descending order, and explain the method of ordering.**
- **Explain why overlapping or leaving gaps does not result in accurate measures.**
- **Estimate and measure an object using multiple copies of a non-standard unit and using a single copy of the same unit many times, and explain the result.**

Suggestions for Instruction

Note: Students will need the measurement process modelled. Use a non-standard unit and demonstrate how to use it to measure an object. Talk about the importance of beginning at the one end of the object and placing the unit end-to-end without leaving spaces or overlapping. Demonstrate the difference in measurement when the objects are lined up end-to-end, when gaps are left, or when units are overlapped.

- Present students with the following problem.

    "I want to measure the length of the table (or any object) with this unit (select something that students have not used; for example, a whiteboard/chalk brush), but I only have one of them. How do you think we can do this?"

    Brainstorm for ideas. Have students try their suggestions.

    If students do not suggest the iteration (repeating) of the unit, model the process.

    Example:

    Place the brush at one end of the table. Make a mark or put a finger at the end of the brush. Move the brush up to the mark/finger. Repeat until the other end is reached. Talk about the need to have some way of keeping track of the number of iterations.

- Have students practise measuring objects with multiple copies of the same unit and then with a single copy of the same unit and compare the results. Ask students to give reasons for any discrepancies.

- Model for the class the language of estimation as well as the act of estimating (e.g., "I think this book is about 15 cubes on this edge."). Other estimation terms include the following: *is almost*, *is close to*, *is approximately*, *is near to*.

- Ask questions to demonstrate the reasonableness of estimates, such as "Is this pencil 6 paper clips or 60 paper clips long?" "Is this string 10 rods or 100 rods long?"

- **What Does It Measure?** Have students work with a partner to measure a variety of classroom objects and record their results.

Example:

Object	Unit of Measure	Estimate	Actual
table	craft stick	8 craft sticks	12 craft sticks
book	unifix cube	10 cubes	9 cubes

- Provide small groups of students with three or four objects, each with a different length and mass. If possible try to have one of the shorter objects weigh more than the others. Have students measure the length of the objects and then order them from the longest to the shortest. Record their results.

  Then, have students find the mass of the objects and order them from heaviest to lightest. Record their results.

  Extension: Have students compare the results. Ask questions such as:

  - Is the longest/tallest object the heaviest?

  - Is the shortest object the lightest?

  - Do you think that you can predict the mass of an object by looking at its height? Why or why not?

  - If someone told you the mass of a hidden object do you think that you could predict the height? Why or why not?

Assessing Understanding

Kim measured the top of the table using rods.
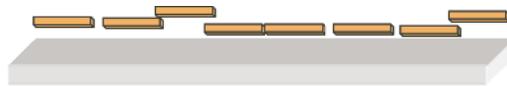
The table measured 8 rods. Is the answer correct? Explain your thinking.

- **Estimate and measure, using non-standard units, a length that is not a straight line.**

Suggestions for Instruction

Note: The learning experiences for this achievement indicator are appropriate for measuring distance around (circumference).

- Draw curved or zigzagged lines on large pieces of paper or make them with masking tape on the floor. Ask students how they might measure the length of the lines. Try some of the suggestions. If the use of string or ribbon is not mentioned, introduce the method and demonstrate the procedure.

  Example:

  Lay a piece of string on top of the line. Cut the string when you reach the end. Stretch the string into a straight line and then measure.
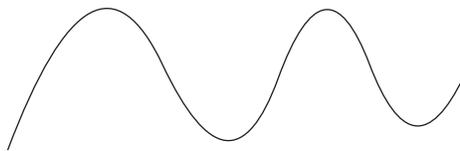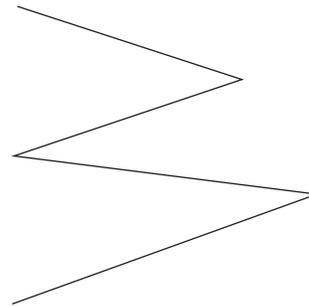
A   B

  Have students use the string to measure the distance around (circumference) cylinders, pumpkins, et cetera.

> ■ **Create different rulers, using non-standard units of measure, and use these rulers to measure length.**

Suggestions for Instruction

■ Ask students about any problems they have encountered measuring. If no problems are identified, suggest the following:

- ▪ units being accidentally bumped
- ▪ losing count
- ▪ units are small and hard to handle
- ▪ units are difficult to keep in a straight row
- ▪ hard to measure objects that are vertical (e.g., classroom door)

Ask students for possible solutions.

■ Have students make their own rulers. Some possibilities include

- ▪ a string of beads (two colours grouped in fives or tens)

- ▪ a long strip of paper with the actual objects taped to the paper (adding machine tape works very well)

Tape down one of the objects and then mark off iterations.

Mark only the iterations.

■ **Measure an object, change the orientation, re-measure, and explain the results.**

Suggestions for Instruction

■ Students work with a partner to measure the length and height of an object such as a box. Have them turn it over, rotate it, or stand it on its end and re-measure. Record their results.

Have the results shared and discussed with the class.

BLM
2.SS.4.2

Assessing Understanding: Measurement Tic-Tac-Toe

Have students select and complete a minimum of one activity from each row.

Measure the length of three different objects. Order the objects from shortest to longest. Record your results.	Select three different objects. Find their length and their mass. Record your results.	Find the mass of three different objects. Order them from heaviest to lightest. Record your results.
Make your own "ruler." Use it to measure two different objects. Record your results.	Measure the masking tape lines on the floor. Record your results.	Demonstrate how to measure an object using only one unit.
Explain how to estimate length.	If you change the position of an object, do its measurements change? Explain your thinking.	Measure an object of your choice. Explain your choice of unit.

Poster Project

Organization:

partners

Materials:

large sheet of paper

markers, crayons, et cetera

Context:

Tell students that they have been asked to design a measurement poster for a teacher store. If possible, show students a commercially prepared poster. Ask students what they notice about the poster. Possible answers may include

- colourful
- information is easy to read
- not cluttered, neatly done
- divided into sections
- poster topic is prominent

Have students follow the design process (from science) to create their poster (discuss possible solutions, develop criteria, create a plan/diagram, make the prototype).

The poster should

- use/explain measurement vocabulary (unit, length, mass, etc.)
- show/explain how to measure using a set of units or using one unit and repeating it
- include pictures/diagrams
- include an example of ordering

Look for an understanding of

- measurement vocabulary
- length and mass
- ordering
- measurement with a set of non-standard units
- measurement with one unit and repeating it

NOTES

Grade 2: Shape and Space (3-D Objects and 2-D Shapes) (2.SS.6)

Enduring Understanding:

Geometric shapes and objects can be classified by attributes.

Essential Questions:

What are the attributes of a shape or object?
What are ways shapes or objects can be sorted?

SPECIFIC LEARNING OUTCOME(S):	ACHIEVEMENT INDICATORS:
2.SS.6 Sort 2-D shapes and 3-D objects using two attributes, and explain the sorting rule. [C, CN, R, V]	➤ Determine the differences between two pre-sorted sets, and explain the sorting rule. ➤ Identify and name two common attributes of items within a sorted group. ➤ Sort a set of 2-D shapes (regular and irregular) according to two attributes, and explain the sorting rule. ➤ Sort a set of 3-D objects according to two attributes, and explain the sorting rule.

PRIOR KNOWLEDGE

Students may have had experience

- sorting 3-D objects and 2-D shapes using one attribute
- explaining the sorting rule

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., 38 can be grouped as 30 and 8 or 35 and 3).

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

Regular 2-D shapes are those that are commonly seen. They have equal sides and equal angles.

Irregular shapes are those that are less common. They have sides and angles that are not equal.
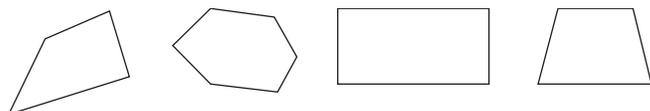
Mathematical Language

colour words

student-chosen vocabulary for shape (specific 2-D and 3-D names, corners, sides, edges, round, 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

attribute

Assessing Prior Knowledge

Work with small groups.

Give students a small group of 3-D objects.

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.

Give students a small group of 2-D shapes.

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

The students are able to

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

- **Determine the differences between two pre-sorted sets, and explain the sorting rule.**
- **Identify and name two common attributes of items within a sorted group.**
- **Sort a set of 2-D shapes (regular and irregular) according to two attributes, and explain the sorting rule.**
- **Sort a set of 3-D objects according to two attributes, and explain the sorting rule.**

Suggestions for Instruction

- **Game: What's My Rule?** Sort a small number of students into two groups (e.g., laced shoes, not laced shoes), without telling the students how they are being sorted. One at a time, the rest of the students go to the group to which they think they belong. Tell them whether or not they are in the correct group. When all students are in the groups, ask "What's my rule?" Repeat using other characteristics of children.

  Extension:

    Sort students using two attributes.

    Play the game using 3-D objects or 2-D shapes.

    Let students take turns doing the sorting.

- **Sorting Attribute Blocks:** Show students a set of attribute (logic) blocks. Have students take turns selecting two of the blocks and then stating how they are alike and how they are different.

  Example:

  "These shapes are both squares but one is red and the other is blue."

  Sort the attribute blocks into two groups according to two attributes and have students identify the sorting rule.

  > Attribute blocks differ in size, shape, colour, and thickness. Although 3-D objects, they are described using 2-D names.

  In small groups, a student randomly selects a card and shows it to the group. The group then sorts the attribute blocks according to the attributes on the card.

  Cards:

colour and size	shape and size	shape and thickness
size and thickness	colour and shape	colour and thickness
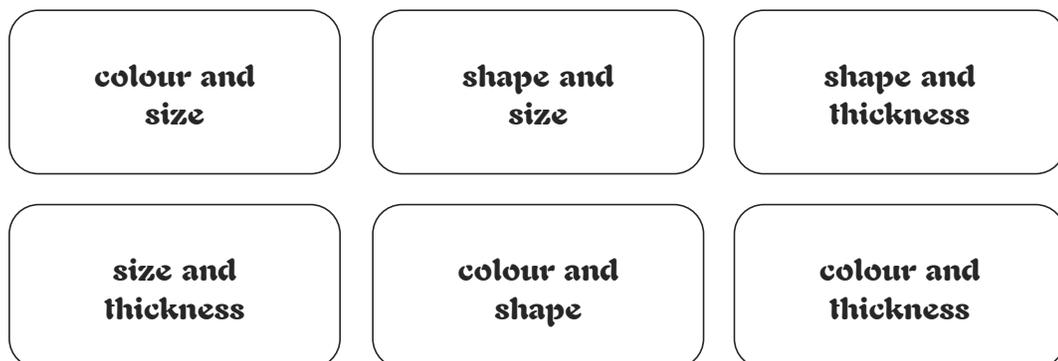
- **Button Sort:** Sort a set of buttons using two attributes. Have students guess the sorting rule.

Example:
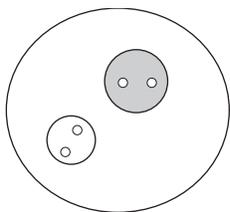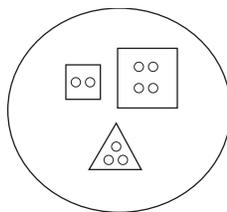
round and two holes   not round and not two holes

Have small groups of students sort sets of buttons using two (or more) attributes, write the sorting rule on a piece of paper and turn it upside down on the table/desk. Groups then change places and try to guess the sorting rule.

- **Attribute Mats:** Students can use problem-solving attribute mats as they recognize and identify the similarities and differences among attribute (logic) blocks or 3-D objects. Attribute mats consist of circles with lines connecting them. Each line represents a difference between the objects in the two joined circles (e.g., two lines indicate two differences between the connected objects). The teacher can make several attribute mats, each with a different number of circles and numbers of lines connecting the circles. With a given attribute mat, a student selects the attribute blocks (or other objects) to place in the circles.

Sample problem-solving attribute mat:
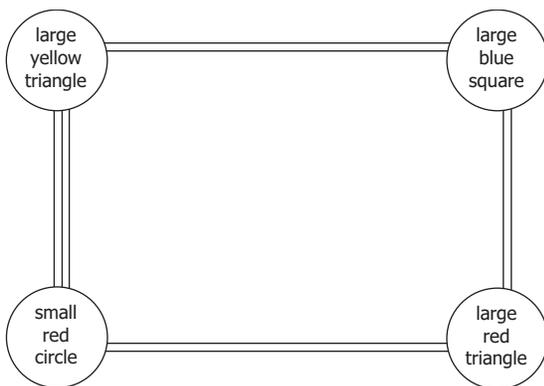
■ Use a Venn diagram for sorting.

Example:

Venn Diagram
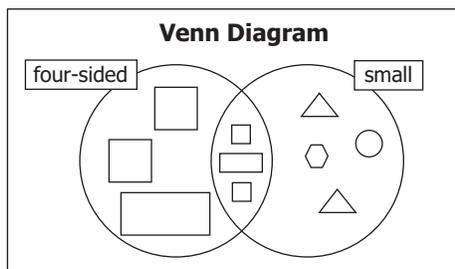
four-sided   small

This Venn diagram shows a sort by two attributes—four-sided and small. The intersection of the two circles contains figures that share both attributes.

Assessing Understanding

Give students a small group of regular and irregular 3-D objects.

1. Have them sort them according to two attributes and then state their sorting rule.

2. Sort a set of objects into two groups. Have students identify the sorting rule.

Give students a small group of regular and irregular 2-D shapes.

1. Have them sort them according to two attributes and then state their sorting rule.

2. Sort a set of objects into two groups. Have students identify the sorting rule.

Observation Checklist

The students are able to

❑ sort a collection of 3-D objects according to two attributes

❑ sort a collection of 2-D shapes according to two attributes

❑ state the sorting rule   3-D   2-D

❑ identify the sorting rule of a pre-sorted set   3-D   2-D

Shape and Space (3-D Objects and 2-D Shapes) (2.SS.7, 2SS.8, 2.SS.9)

Enduring Understandings:

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 can 3-D objects and 2-D shapes be described?
What are the attributes of 3-D objects and 2-D shapes?

SPECIFIC LEARNING OUTCOME(S):	ACHIEVEMENT INDICATORS:
2.SS.7 Describe, compare, and construct 3-D objects, including ■ cubes ■ spheres ■ cones ■ cylinders ■ prisms ■ pyramids [C, CN, R, V]	➜ Sort a set of 3-D objects, and explain the sorting rule. ➜ Identify common attributes of cubes, spheres, cones, cylinders, prisms, or pyramids from sets of the same 3-D objects. ➜ Identify and describe 3-D objects with different dimensions. ➜ Identify and describe 3-D objects with different orientations. ➜ Create and describe a representation of a 3-D object using materials such as modelling clay. ➜ Identify examples of cubes, spheres, cones, cylinders, prisms, or pyramids found in the environment.
2.SS.8 Describe, compare, and construct 2-D shapes, including ■ triangles ■ squares ■ rectangles ■ circles [C, CN, R, V]	➜ Sort a set of 2-D shapes, and explain the sorting rule. ➜ Identify common attributes of triangles, squares, rectangles, or circles from sets of the same type of 2-D shapes. ➜ Identify 2-D shapes with different dimensions. ➜ Identify 2-D shapes with different orientations. ➜ Create a model to represent a 2-D shape. ➜ Create a pictorial representation of a 2-D shape.

(continued)

SPECIFIC LEARNING OUTCOME(S):	ACHIEVEMENT INDICATORS:
2.SS.9 Identify 2-D shapes as parts of 3-D objects in the environment. [C, CN, R, V]	➜ Compare and match a 2-D shape, such as a triangle, square, rectangle, or circle, to the faces of 3-D objects in the environment. ➜ Name the 2-D faces of a 3-D object.

PRIOR KNOWLEDGE

Students may have had experience

- replicating composite 2-D shapes and 3-D objects
- comparing 2-D shapes to parts of 3-D objects in the environment

BACKGROUND INFORMATION

Pierre van Hiele and Dina van Hiele-Geldof, mathematics teachers from the Netherlands in the 1950s, researched the development of geometry thinking (cited in Van de Walle and Folk 427–432). 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

cube	square
cylinder	rectangle
sphere	circle
cone	2-D shape
pyramid	3-D object
triangle	prism

LEARNING EXPERIENCES

Assessing Prior Knowledge

1. Give students a composite 2-D shape and have them reproduce it.
2. Give students a composite 3-D object and have them reproduce it.
3. Show students a rectangle and have them give examples of 3-D objects that have parts that are rectangles.

Observation Checklist

The 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
- ❏ identify 3-D objects in the environment that have rectangular parts

- **Identify common attributes of cubes, spheres, cones, cylinders, prisms, or pyramids from sets of the same 3-D objects.**
- **Identify and describe 3-D objects with different dimensions/orientations.**
- **Create and describe a representation of a 3-D object using materials such as modelling clay.**
- **Identify examples of cubes, spheres, cones, cylinders, prisms, or pyramids found in the environment.**

Suggestions for Instruction

- Provide students with sets of cubes, spheres, cones, cylinders, prisms, or pyramids. Each set should contain objects of different sizes. Have students compare the objects and identify the common attributes. Record the attributes on a chart.

  Example:
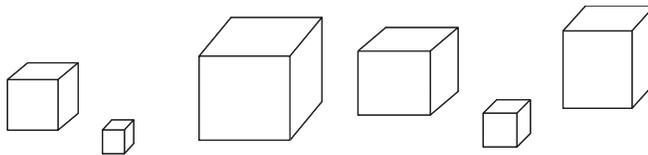
  Attributes of a cube:
  - has six square faces (accept informal term "sides")
  - the faces are all the same size
  - has eight vertices (accept "corners")

- **3-D Object Sort:** Provide students with a set of cards with pictures of cubes, cylinders, spheres, cones, prisms, and pyramids in different orientations. Have students sort the pictures under the correct headings.

  Example:
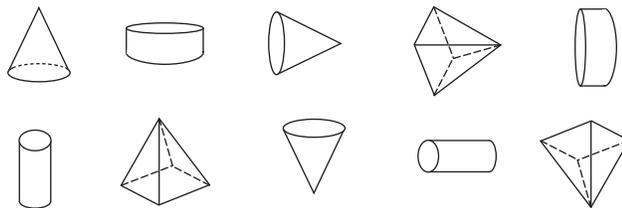
  BLM
  2.SS.7.1

Cylinders	Cones	Pyramids

- Students use play dough, plasticine, or modelling clay to make particular 3-D objects. Have students describe their object orally or in writing.

- **Scavenger Hunt:** Have students go on a scavenger hunt to find examples of the 3-D objects in the environment. A digital camera can be used to record their findings. The pictures could then be made into a class book.

Assessing Understanding

Show two of the following 3-D objects.
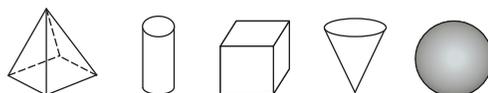
a) Describe each of them in as many ways as possible.

b) Tell where these objects can be found in the classroom/school.

Observation Checklist

The student is able to

❑ identify the object

❑ identify the attributes of the object

❑ identify examples of the objects in the environment

- **Identify common attributes of triangles, squares, rectangles, or circles from sets of the same type of 2-D shapes.**
- **Identify 2-D shapes with different dimensions/orientations.**
- **Create a model and a pictorial representation to represent a 2-D shape.**

Suggestions for Instruction

- Provide students with paper or pictorial sets of triangles, squares, rectangles, or circles. Each set should contain shapes of different sizes. Have students compare the shapes and identify the common attributes. Record the attributes on a chart.

  Example:
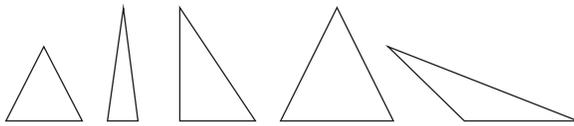
  Attributes of a triangle

  - has three sides
  - has three corners (accept "points")
  - is a 2-D shape (is flat)

- **2-D Shape Sort:** Provide students with a set of cards with pictures of triangles, squares, circles and rectangles in different orientations. Have students sort the pictures under the correct headings.

  Example:

  BLM
  2.SS.7.2
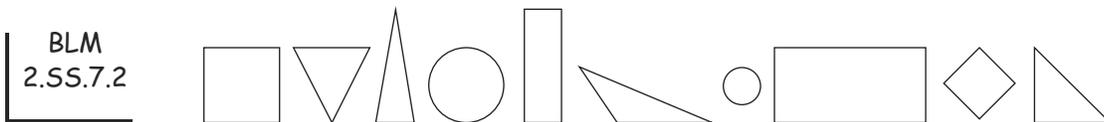
Triangles	Squares	Rectangles	Circles

- Have students create paper models of 2-D shapes. Use the paper models to make pictures. Have students describe their creations.

  Example:
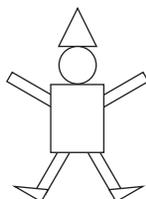
  "My picture has five rectangles, one circle, and three triangles."

- Have students create drawings using particular 2-D shapes.

  Example:

  Draw a picture that uses at least three triangles, four rectangles, two squares, and one circle. Label the 2-D shapes in your picture.

Assessing Understanding: Journal Entry

a) Explain why these are all triangles.

b) Which shape does not belong? Explain your thinking.

Class Riddle Book

Organization:

pairs

Materials:

paper

markers, coloured pencils, et cetera

digital camera (optional)

Context:

Tell students that they are going to make a class riddle book for 3-D objects and 2-D shapes. Show students an example.

Example:

I am a 2-D shape.

The white/chalk board has my shape.

I am found on the covers of most books.

I am a face on a cereal box.

I have four sides, two long and two short.

What am I?

Small piece of paper glued at the top only.

rectangle

Labelled picture/drawing hidden underneath.
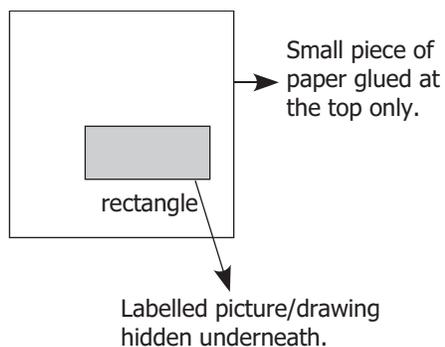
Observation Checklist

The students are able to

❑   select and correctly name a 3-D object or 2-D shape

❑   identify examples in the environment

❑   identify attributes of the object/shape

❑   put the information together in the form of a riddle

Notes