# GRADE 4 MATHEMATICS

## Shape and Space

# Grade 4: Shape and Space (Measurement) (4.SS.1, 4.SS.2)

**Enduring Understandings:**

The attributes of a clock help to read time.

Reading time on a clock can help communicate the measurement of time.

Elapsed time is the measure of the duration of an event.

A given time of day can be represented in more than one way.

The attributes of a calendar help to read and record dates and help to organize events in life.

**Essential Questions:**

How do we use time throughout the day?

How can the time on a clock be read and recorded?

How can the date be recorded in several ways?

| Specific Learning Outcome(s): | Achievement Indicators: |
|---|---|
| **4.SS.1** Read and record time using digital and analog clocks, including 24-hour clocks. [C, CN, V] | ➛ State the number of hours in a day.<br>➛ Express the time orally and numerically from a 12-hour analog clock.<br>➛ Express the time orally and numerically from a 24-hour analog clock.<br>➛ Express the time orally and numerically from a 12-hour digital clock.<br>➛ Describe time orally and numerically from a 24-hour digital clock.<br>➛ Describe time orally as "minutes to" or "minutes after" the hour.<br>➛ Explain the meaning of AM and PM, and provide an example of an activity that occurs during the AM and another that occurs during the PM. |
| **4.SS.2** Read and record calendar dates in a variety of formats. [C, V] | ➛ Write dates in a variety of formats (e.g., yyyy/mm/dd, dd/mm/yyyy, March 21, 2006, dd/mm/yy).<br>➛ Relate dates written in the format yyyy/mm/dd to dates on a calendar.<br>➛ Identify possible interpretations of a given date (e.g., 06/03/04). |

## Prior Knowledge

Students have had experience

- relating the passage of time to common activities using non-standard and standard units (minutes, hours, days, weeks, months, years)
- determining the number of days in any month using a calendar
- solving a problem involving the number of minutes in an hour or the number of days in a given month
- creating a calendar that includes days of the week, dates, and personal events

## Background Information

Clocks and calendars are used to organize the daily activities in our lives. Clocks and calendars should be used as tools to measure time like rulers measure length.

Time is abstract and it cannot be seen, so it is a challenge to fully understand. Students need many experiences relating the passage of time to events in their lives. They need to understand that the duration of an event/activity is determined by its start and end times and that there are standard units that we can use to describe the duration. Students should develop personal referents (length of a class or television show) to understand duration.

An **analog clock** is a clock with a minute hand and an hour hand.

A **digital clock** is a clock on which the time is displayed numerically (e.g., the time is displayed as 12:22).

The abbreviation, A.M., is the short form for *ante meridiem* meaning "being before midday" and P.M. is the abbreviation for *post meridiem* meaning "being after midday."

**Note:** It is also acceptable to write AM and PM in the following ways:

- 11:30 am
- 11:30 AM
- 11:30 A.M.
- 11:30 a.m.
- 11:30am

It is also important to have students benefit from having experiences with time throughout the day rather than just engaging in activities that narrowly focus on telling time. The reading and recording of time is best learned through authentic learning experiences that happen throughout the year and can be integrated into other subject areas and events to make it meaningful to students.

Through the learning outcome 4.SS.2, students will become aware of the variety of ways dates can be recorded. There are many different ways that dates are written in numeric format. There are several acceptable formats that can be used. The International Organization for Standardization has indentified a standard notation that many countries, including Canada, have adopted. It starts with the year, then the month, followed by the day (yyyy-mm-dd). June 12, 2016, would be recorded 2016-06-12.

## Mathematical Language

minutes
hours
days
weeks
months
years
seconds
time
o'clock
analog clock
digital clock
12-hour clock
24-hour clock
AM
PM
calendar
hours
days
weeks
months
years

## Learning Experiences

### Assessing Prior Knowledge: Interview

Ask students the following:

- Would you use minutes or would you use hours to measure
  - the length of the school day?
  - the length of recess?

  Explain your choices.
- Milo's video is 85 minutes long. Is that more or less than an hour? Explain how you know.
- Sally's mother said that she could play at her friend's for either two hours or for 150 minutes. Which one should she choose if she wants to play for as long as she can? Explain your choice.

The student

- ❒ understands when to use minutes and hours to measure the passage of time
- ❒ understands that there are 60 minutes in an hour
- ❒ applies this information in a problem-solving situation
- ❒ understands that there are 60 seconds in a minute

Interview: Ask students the following:

- Can you show what the date is on the calendar? Have them write it out.
- How many months are there in one year?
- How many days are in one week?
- How many days are in two weeks?

The student understands

- ❒ what a calendar is, and how to read it
- ❒ the relationship between days, weeks, and months

## Suggestions for Instruction

- **Exploration of Time:** Telling time will likely be a concept that is familiar to students. Whether the concept was formally or informally introduced to students, they will know something about it. When formally teaching the concept, it is good to focus on the essential questions:
  - Why do I need standardized units of measurement?
  - Why do I need to tell the time?
  - What is important about telling time?
  - How does telling time help us in our lives?

  These questions will lead into a discussion that will help engage students and also help you assess what students know and feel about the concept. Student learning and engagement increase when students become aware of their learning and make connections to other concepts. By making connections, students draw on or add to their understanding.

BLM 4.SS.1.1

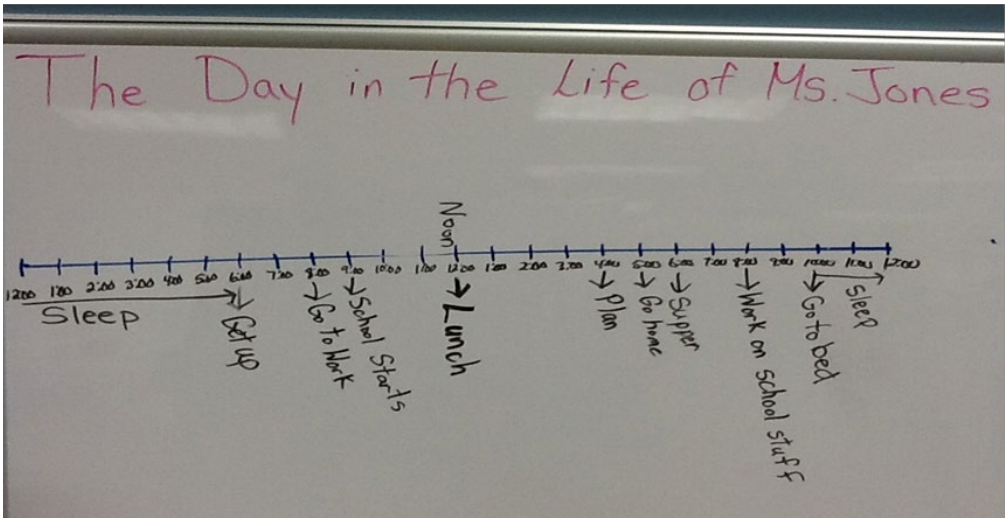
- **Telling Time Makes Me Think Of:** Activate the formal unit on time by using the BLM 4.SS.1.1, *Telling Time Makes Me Think Of . . .,* as way to get a good idea of what students know about time and the related vocabulary. Each student will record words, phrases, numbers, and pictures of what they know about time. As a whole class or in small groups, have students share what they have written and explain their choices. Throughout the discussion, help students make connections to other math concepts, connect to prior knowledge, and recognize how interconnected math concepts relate to everyday life. Throughout the year, have students go back to the page to expand on their thoughts.

- Explore familiar occurrences/events associated with particular times (time of day, week, year) within the students' local and extended community. This would be an ideal time to make links to the learning outcomes of the social studies curriculum.

- **State the number of hours in a day.**

## Suggestions for Instruction

- **The Day in the Life of _____:** While time is often described using the 12-hour clock, students should realize that there are 24 hours in a day. Tell the students that the timeline shows all the hours in a day. Discuss and record events of your day over a 24-hour period using a timeline. Discuss the relationship between the hours in a day and the timeline. Ask students why the times are recorded twice. This can lead to discussion about how to differentiate between AM and PM. Start the discussion off by asking students why it is important to say the time of day when describing time.




- **Explain the meaning of AM and PM, and provide an example of an activity that occurs during the AM and another that occurs during the PM.**

## Suggestions for Instruction

BLM 4.SS.1.2

- **Student Timeline:** Have students use BLM 4.SS.1.2, *Timeline: The Day in the Life of _____*, or have them create their own timeline. If possible, make the timeline on cardstock. The students will be able to use this timeline for the next learning experience. Explain to students that 12 noon is the bridge between AM and PM times, and that times between 12 midnight and 12 midday are AM times, and that times between 12 midday and 12 midnight are PM times.

- **AM and PM Sort:** Have students write different activities from their timeline on index cards. Have students sort the cards into AM or PM hours.

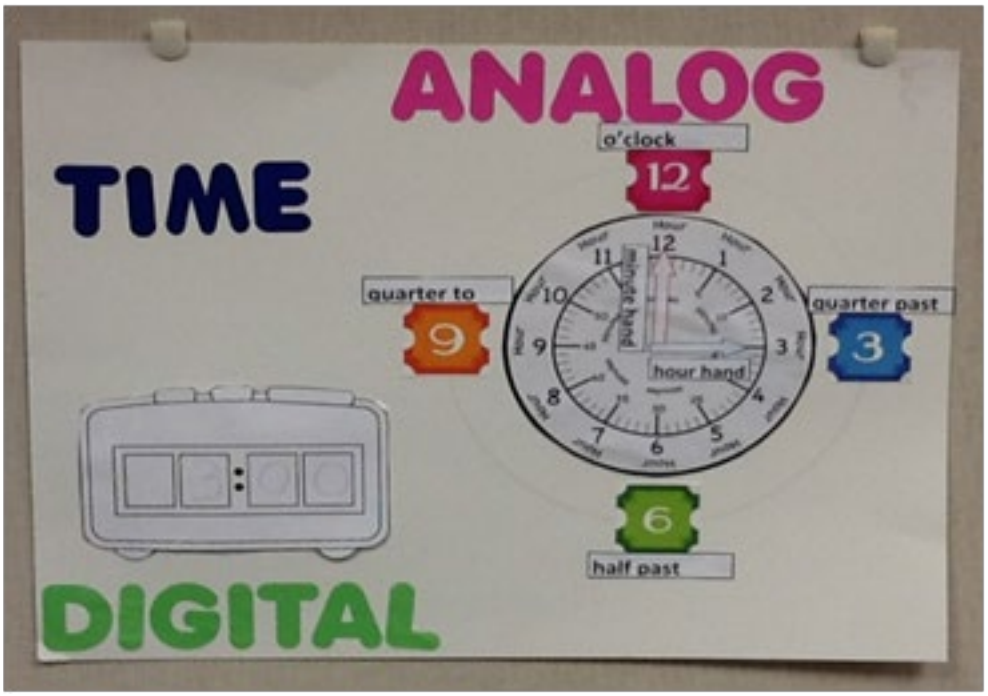
BLM 4.SS.1.3

- **AM and PM Activities:** Have students list the activities they do on the hour throughout the day and record them using BLM 4.SS.1.3, *AM and PM Activities*.
- Find out about arrival and departure times of boats, ferries, planes, buses, or trains in your community. Have students bring in tickets from the different modes of transportations and compare times on them.

- **Express the time orally and numerically from a 12-hour analog clock.**
- **Express the time orally and numerically from a 12-hour digital clock.**
- **Describe time orally as "minutes to" or "minutes after" the hour.**

## Suggestions for Instruction

- **Clock Collection:** Have students collect pictures of different clocks and watches from magazines, newspapers, and catalogues. Display the pictures and talk about the different ways the clocks display times. Introduce the students to analog and digital vocabulary. Review the different parts of clocks and make a class anchor chart. Try to find different types of analog and digital clocks to display in the room.



- **Make a Clock:** Have students make their own clocks by gluing a clock face to a paper plate. Have students attach two arrows made from heavy paper with a brass fastener to make hands. Have them move the hour hand on their clocks as you talk about the time. To get a BLM of clock faces go to http://lrt.ednet.ns.ca/PD/BLM/table_of_contents.htm.
- **Analog Clock:** Have students look at an analog clock. What do they notice? What do they wonder? Record their observations.

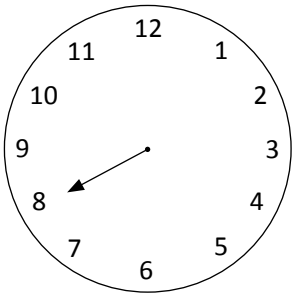

Example:

| What we notice | What we wonder |
|---|---|
| The clock has the numbers 1 to 12. | Do all clocks have the numbers 1 to 12? |
| There are little lines in between the numbers. | Why are the lines there? |
| The clock has two hands—one short and one long. | Why are the hands different lengths? |
| The longer hand moves quickly around the clock face. The shorter hand moves very slowly. | Why do the hands move at different speeds? |

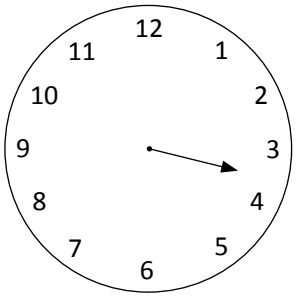
Guide students in finding answers to their wonderings.

- **Telling Time:** It is easier to tell the time on the hour, half past the hour, a quarter past the hour, and a quarter to the hour; however, many daily activities do not begin at these times. Where possible, connect telling time on the analog clock with meaningful events in the students' lives such as the daily class schedule or agenda.
- Review with students to show what "a little after the hour," "a little to the hour," and "half past" look like with the hour hand. For example, when it is "half past" the hour, the hour hand is pointed directly between the two numbers. Use a one-handed clock to help students understand and read analog clocks. Remove the minute hand from an old clock and set the short hand in varying places. Use language such as the following:

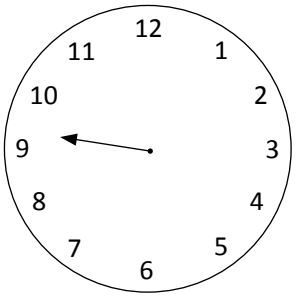
"It's about 8 o'clock."




"It's halfway between 3 o'clock and 4 o'clock."




"It's a little bit past 9 o'clock."




- **Making Connections to Digital Time:** Showing the time with a digital clock may be introduced concurrently with the time on an analog clock. Representing both ways will help students make connections.
- **Slit Clocks:** Have students make slit clocks if they need more examples of telling time to the hour. See below for steps and pictures. The slit clock helps students to tell the hour when it is not pointing directly at a number. When the number is beyond an hour, have them practise saying a little past the hour ("a little after 6:00 o'clock"). If the hand is a little before an hour, have them practise saying a little before the hour ("a little before 6:00 o'clock"). Have students practise with a partner. They can both show times and read the times to each other.

Step 1

On a paper plate, draw the numbers of a clock face. Cut a slit from the number 12 to the midway point of the plate.

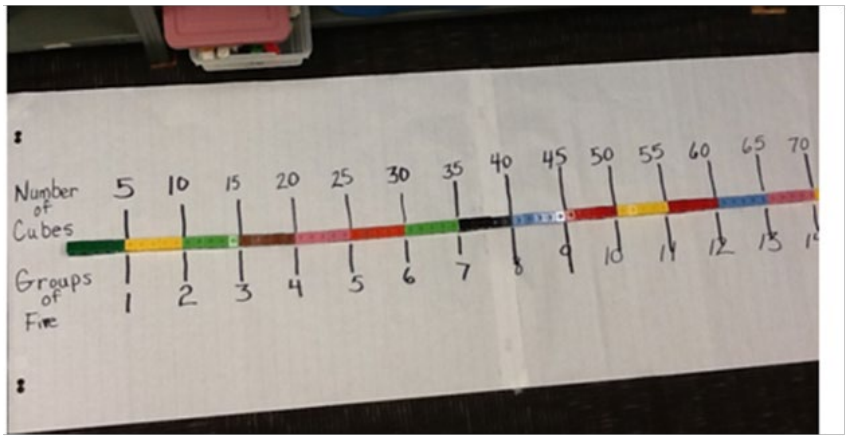
Step 2

Cut out the middle circle of another plate. Draw the hour hand onto the cut-out middle part, and cut along this hour hand.

Step 3

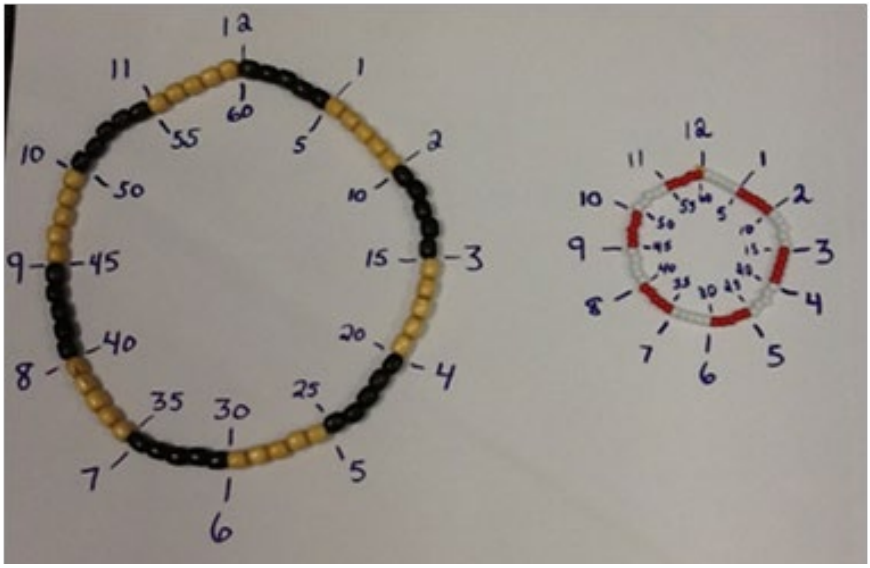
To complete the clock, slide the small circle through the slit on the clock. Move the inner circle from the back and hold the clock with the other hand.

- **Developing an Understanding of Minutes on the Clock (Part 1):** This activity may help students understand the minutes of a clock. Give each student five linking cubes of the same colour. On a few pieces of chart paper glued end to end, have students place their five linked cubes onto the chart paper. The goal is to create a number line with twelve groups of five linking cubes. Record each group of five by drawing a vertical line segment at the right end of the cubes. Discuss the relationships between the number of groups of five cubes and the total number of cubes.




- **Making Relationships to the Clock (Part 2):** Have an analog clock ready for display. Ask students if they see any relations between a clock and the number line that was created. You may want to remove the section of the cubed number line beyond twelve groups of five. Ask students if they could use the cubed number line to tell the time.

  Have students create a number line out of twelve groups of five linking beads and connect them on a string. Beads work well because they can be brought together end to end to make a clock. Make a model of a clock by having students use two colours, and alternate the groups of five with the two colours to a total of 60 beads. Have students label their clocks. Label the hour and interval of each group of five beads. This transitional clock is a visual image that shows both the number of groups of five beads (hours) and the total number of beads (minutes). Have a discussion about the minute hand by making a minute hand and using it to demonstrate how to tell minutes on a clock.



Larger beads can be used to make a class model.



Smaller beads can be used for students to make their own clocks.

BLM 4.SS.1.4

- **Analog and Digital Clocks:** Use BLM 4.SS.1.4, *Analog and Digital Clock Faces,* or have students draw two analog clock faces and two digital clocks. Ask them to answer the following questions, and have them record both times on both types of clock.
  - What time did you eat breakfast?
  - What time did you leave for school?

  Have the students choose one type of clock to work out the length of time between eating breakfast and going to school. Have a conversation about their choice and the differences between the clocks.

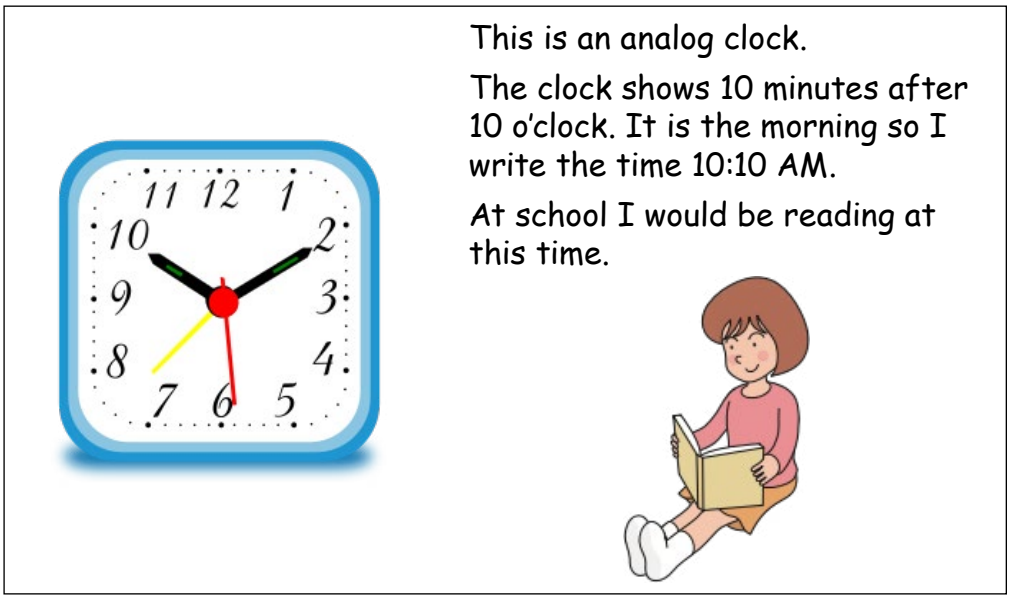
BLM 4.SS.1.5

- **Practise Telling Time:** Use BLM 4.SS.1.5, *Digital Time,* or purchase or make time dice. Partner students up. Have one partner roll the dice or pick a card and have the other partner show the time on a student clock model. Clock models can be made or purchased. You can also purchase inexpensive clocks at dollar stores.

- **Representing Time:** Explore all the different ways that time can be shown. Set an alarm clock to go off several times in a day. Have students record the time in their journals using analog, digital, and written forms.

| Representing Time | | |
|---|---|---|
| Time | Numerically represented | Orally or in written form |
| 3:35 | ■ 3:35 | ■ Thirty-five minutes after three o'clock<br>■ Twenty-five minutes to four o'clock<br>■ Thirty-five minutes past three o'clock<br>■ Twenty-five minutes before four o'clock<br>■ Three thirty-five |
| 8:30 | ■ 8:30 | ■ Eight thirty<br>■ Thirty minutes after eight o'clock<br>■ Thirty minutes to nine o'clock<br>■ Half past eight |
| 2:15 | ■ 2:15 | ■ Fifteen minutes after two o'clock<br>■ Forty-five minutes to three o'clock<br>■ Two fifteen<br>■ Quarter past two<br>■ Quarter past two o'clock |
| 6:00 | ■ 6:00<br>■ 6 o'clock | ■ Six o'clock |

- **Make Posters:** Have students make posters illustrating how to write and say the time. Have students give an example of what they would be doing during that time.



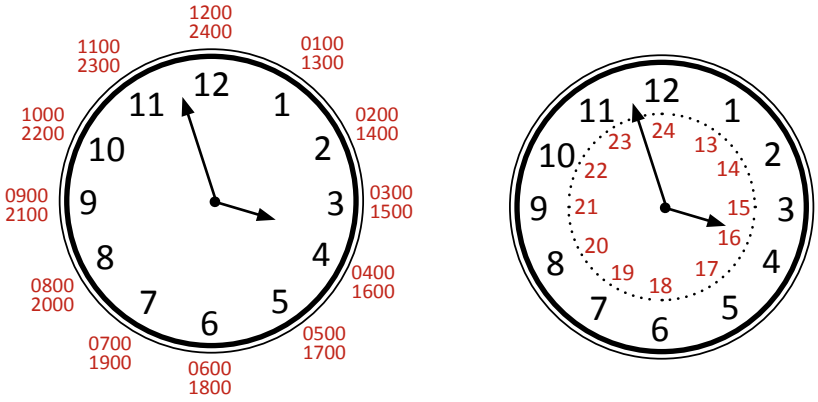

BLM 4.SS.1.6/ 4.SS.1.7

- **Match Game:** Have students make a class matching game. Ask each student to make two cards showing the same time, one analog and one digital. Place everyone's cards together in a learning centre so students can practise matching the two different times. Use BLM 4.SS.1.6, *Analog Clock Faces,* and BLM 4.SS.1.7, *Digital Clock Faces,* as possible templates.

- **Express the time orally and numerically from a 24-hour analog clock.**
- **Describe time orally and numerically from a 24-hour digital clock.**

## Suggestions for Instruction

The 24-hour clock is a system used for telling time in which the day runs from midnight to midnight. The time on a 24-hour clock is shown as how many hours and minutes have passed since midnight. The 24-hour clock removes the confusion of whether the time is AM or PM. Students may have come across situations where the 24-hour clock is used. The time of day is written in the format of hh:mm in the 24-hour notation. The hour is always written as a 2-digit number; therefore, any hour below 10 has a zero before it.




BLM 4.SS.1.8

- **Find 24-Hour Clock Notations:** Show a few samples using the 24-hour time notations. BLM 4.SS.1.8, *24-Hour Clock Notations,* has some examples. Ask students what they notice about the time. Explain to them that the time is written using 24-hour notation. Show a 24-clock to the students and discuss what they see. Have students find other 24-hour notations and share them with the class.

- **Advantages and Disadvantages:** Discuss with the students the advantages of using a 24-hour clock. (You do not have to use AM or PM, and there is no confusion about what time of day it is.)

  Discuss with the students the disadvantages of using a 24-hour clock. (It can be hard to know what times like 15:00 mean because most people do not use a 24-hour clock to tell time.)

- **Reading and Recording:** Show different times on a 24- and 12-hour digital and analog clock. (Most digital alarm clocks will have a setting for 24-hour time.) Have students practise recording and saying the time.

Ask students if there is a good way to convert between 24-hour and 12-hour notation for times after noon. (You can add 12 to go from 12-hour clock notation to the 24-hour clock notation. You can subtract 12 to go from the 24-hour clock notation to a 12-hour clock notation.)

**Note:** Converting between the different formats takes practice. Post schedules that use all the different formats and encourage students to use and say the different formats throughout the year.

- The Sparklebox Teacher Resources website contains free printable clock visuals of different analog and digital formats. They can be reproduced for practice and matching activities. "Digital Times Teaching Resources" can be found at http://www.sparklebox.co.uk/maths/shape-space-measures/time/digital-times.html
- Once students have a good understanding of telling time, websites such as the following can help them practise telling the time:
  http://www.maths-games.org/time-games.html
  http://classroom.jc-schools.net/basic/math-time.html

### Assessing Understanding: Paper-and-Pencil Task or Interview

"Fill in AM or PM next to each time":

James had finished breakfast. It was about 8:30 __(AM)__. James heard the phone ring. A friend called to see if he wanted to watch a movie after supper. His mother said yes but he had to be home at 9:30 __(PM)__. He asked whether he could stay overnight at a friend's. She agreed, but she wanted him home in the morning before 11:30 __(AM)__ because he had a doctor's appointment at 1:30 __(PM)__ the next day.

Have students choose an activity they do in a day and have them show the time on an analog and digital clock with the correct AM or PM notation.

Ask students: How do you know what the hour is when you tell time from an analog clock?

Could a digital clock read 3:62? Explain why.

Have students explain why the hour hand cannot be closer to the seven than to the eight if the time is 7:47?

Have students explain why the minute hand cannot point at the six when the hour hand points directly at the three?

Why would you use a 24-hour clock?

Show a time on a digital clock and ask students to

- tell you the time
- show the time on a 12-hour and 24 hour analog clock
- tell you two ways to read the time


Ask them what they could be doing at this time.

---

- **Write dates in a variety of formats (e.g., yyyy/mm/dd, dd/mm/yyyy, March 21, 2006, dd/mm/yy).**
- **Relate dates written in the format yyyy/mm/dd to dates on a calendar.**
- **Identify possible interpretations of a given date (e.g., 06/03/04).**

## Suggestions for Instruction

- **Interpreting Different Date Formats:** Show students a date that can be read in only one way on the board (e.g., 15/04/2015) and ask the students to write it in words (April 15, 2015). After a discussion, write a date that can be misinterpreted (e.g., 08/11/2015) and ask the students to write the date in words (August 11, 2015, or November 8, 2015). Have students discuss what they wrote. (When the date is written with the year at the end, the day is listed first and then the month—smallest unit of time to the largest.)

  Show students a date with the year listed first (e.g., 2017/06/20). What is different in this format? (The month is listed after the year and the date is last—largest unit of time to the smallest.)

- **My Special Dates:** Have the students brainstorm important dates in their lives and have them write them down. Get the students to record each date using the different formats.
  - yyyy/mm/dd
  - dd/mm/yyyy
  - dd/mm/yy
  - June 12, 2015

- **Scavenger Hunt:** Have students engage in a scavenger hunt and have them bring in different formats of dates found in newspapers, calendars, tickets, posters, and magazines to discuss.
- **Changing Dates:** Have partners explore a special day in which the date fluctuates such as Labour Day. Have students record the dates over the past six years in different formats and present them in a poster format to the class.

### Assessing Understanding: Paper-and-Pencil Task or Interview

Ask the students to point out the day's date on the calendar. Have them record and explain the date using the two formats.

Have the students write their birth date using four different formats.

# Grade 4: Shape and Space (Measurement) (4.SS.3)

**Enduring Understandings:**

Objects have distinct attributes that can be measured with appropriate tools.

Standard units provide a common language for communicating measurement.

A measurement must contain a number and a unit.

Area tells how much material is required to cover a shape on the surface of an object.

Different rectangles have different areas.

**Essential Questions:**

How exact does a measurement have to be?

How does the length relate to measuring area?

What referent can you use to estimate area in centimetres?

What referent can you use to estimate area in metres?

| Specific Learning Outcome(s): | Achievement Indicators: |
|---|---|
| **4.SS.3** Demonstrate an understanding of area of regular and irregular 2-D shapes by<br>■ recognizing that area is measured in square units<br>■ selecting and justifying referents for the units $cm^2$ or $m^2$<br>■ estimating area by using referents for $cm^2$ or $m^2$<br>■ determining and recording area ($cm^2$ or $m^2$)<br>■ constructing different rectangles for a given area ($cm^2$ or $m^2$) in order to demonstrate that many different rectangles may have the same area<br>[C, CN, ME, PS, R, V] | ➛ Describe area as the measure of surface recorded in square units.<br>➛ Identify and explain why the square is the most efficient unit for measuring area.<br>➛ Provide a referent for a square centimetre and explain the choice.<br>➛ Provide a referent for a square metre and explain the choice.<br>➛ Determine which standard square unit is represented by a referent.<br>➛ Estimate the area of a 2-D shape using personal referents.<br>➛ Determine the area of a regular 2-D shape and explain the strategy.<br>➛ Determine the area of an irregular 2-D shape and explain the strategy.<br>➛ Construct a rectangle for a given area.<br>➛ Demonstrate that many rectangles are possible for an area by drawing at least two different rectangles for the same area. |

## Prior Knowledge

Students may have had experience measuring length with both standard and non-standard units. They may have also had experience measuring mass and perimeter with non-standard units.

They may have explored the effect that changing the orientation of an object has on the measurements of its attributes (no change).

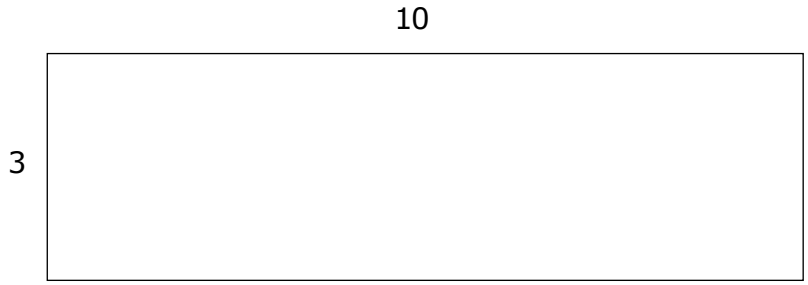
Students may have had no formal experiences with the concept of area.

## Background Information

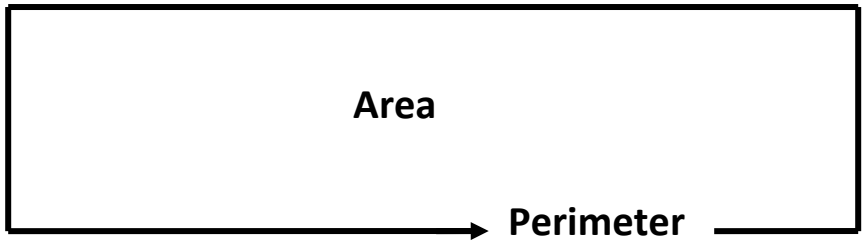
Area is the measure of the interior surface of a closed region or figure; area is measured in square units.

Example:

The area of the following rectangle is 30 square units.




A common misunderstanding of students is confusing perimeter and area. Using a visual reminder as seen below to distinguish between the two measurements may help students.




Centimetre and metre will be two standard units of measurement that students will use. It is important for students to have the time to discover personal referents for these standard units of measurement. Personal referents allow students to visualize measurement and make estimates more accurate. Area is measured in square units. If an object is measured in centimetres, the area would be recorded as $cm^2$.

**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 point of reference used to compare in estimation (e.g., using the width of the baby finger as a referent for a centimetre).

**Length** is the distance from one end of an object to the other end, commonly measured in units of metres, centimetres, millimetres, and kilometres.

**Width** is one dimension of a 2-D or 3-D figure.

**Tiling** is to measure the area of shapes with units of measure that must fit together with no gaps or overlaps.

## Mathematical Language

area
regular
irregular
square units
referents
centimetre
metre
rectangle
shape
estimate

## Learning Experiences

### Assessing Prior Knowledge: Interview

Show students two pieces of paper that have the same area, but look different. Have students compare the two pieces of paper.

The student

- ❒ makes correct comparisons
- ❒ places one object on top of the other to measure, or dissects one piece of paper to see if it fits completely on top of the other
- ❒ uses standard or non-standard units of measure to compare

Show students a rectangle and ask: "If you change the position of the rectangle, do its measurements change? Explain your thinking."

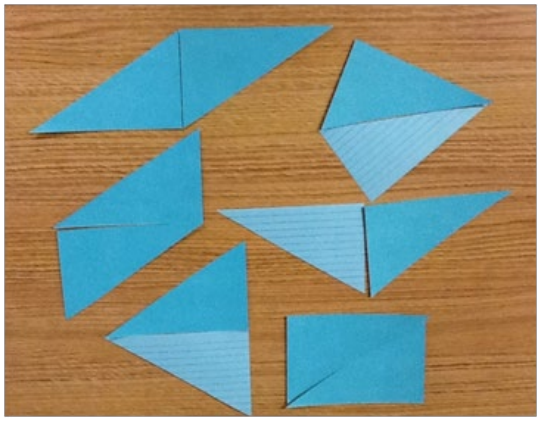
The student

- ❒ explains that the rectangle's measurements have not changed, but the position has changed

- **Describe area as the measure of surface recorded in square units.**
- **Identify and explain why the square is the most efficient unit for measuring area.**
- **Provide a referent for a square centimetre and explain the choice.**
- **Provide a referent for a square metre and explain the choice.**
- **Determine which standard square unit is represented by a referent.**
- **Estimate the area of a 2-D shape using personal referents.**
- **Determine the area of a regular 2-D shape and explain the strategy.**
- **Determine the area of an irregular 2-D shape and explain the strategy.**
- **Construct a rectangle for a given area.**
- **Demonstrate that many rectangles are possible for an area by drawing at least two different rectangles for the same area.**

## Suggestions for Instruction

- **Two-Piece Shapes:** Van de Walle, Karp, Lovin, and Bay-Williams suggest doing this activity as a precursor to developing a good understanding of area.



Give each pair or triad of students six 3 x 5 inch index cards. Have them cut the rectangles on the diagonal, making two identical triangles for each card. Next, have them rearrange the triangles into different shapes. The rule is to have only sides of the same length matched up exactly, and to use only two triangles for each shape.

Have each group of students find all the shapes that can be made. Discuss the area and shape of the different representations.

Questions to ask students:

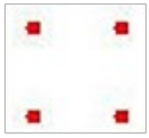
- Does one shape have a greater area than the others?
- Did one take more paper to make?

The goal of the exploration is to have students understand that although each figure is differently shaped, all the representations have the same area (Van de Walle, Karp, Lovin, and Bay-Williams 324).

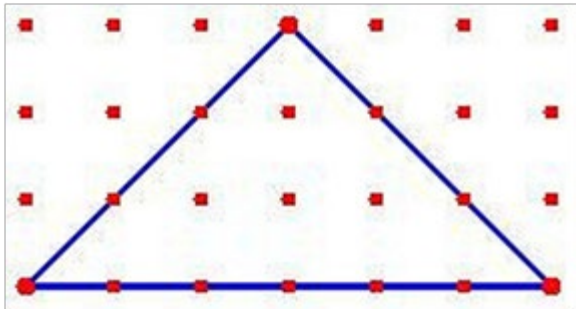
Tangram puzzles can be used for the same purpose.

BLM 4.SS.3.1

- **What Is the Area?** Initial learning experiences should focus on developing the idea that area is measured by covering or tiling. It may be appropriate to start with non-standard units with students before measuring with standard metric units. Pass out BLM 4.SS.3.1 or draw three shapes that have similar areas (two rectangles and an irregular shape). Have students estimate which is the smallest and the largest of the three shapes. Have a set of manipulatives ready so students can measure the areas. The manipulatives can include tiles, Cuisenaire rods, base-10 blocks, unit cubes, pattern blocks, or cubes. It is important for students to have the opportunity to make decisions about which unit to use to measure area. This experience helps students build understanding of area. Discuss with the students their choices and the differences in the measurements. Ask why the numbers of units differ.
- **Area with a Geoboard:** Hand out a geoboard to each student or pair of students. Explain to the students that each square on the geoboard can represent one square unit. Display a shape to the students and have them find the area of the shape, stating the number of square units. After finding the area of a few shapes, state the area, and have students create shapes on their geoboard that have the given area. Have students justify their answers. Have the students compare their shapes. Facilitate the discussion so students see that many different shapes can be created for a given area.



One square unit



The area of this triangle is 9 square units.

BLM 4.SS.3.2

- **Cover the Shape:** If more practice is needed in understanding the attributes of area, have students cover a pattern block mat. Make an outline using four to eight hexagons from a pattern block set. BLM 4.SS.3.2 can also be used. Ask students to cover the shape with each type of pattern block to determine the area. The discussion afterward should be on understanding the area does not change. The smaller the unit, the more units are needed to cover the same area. The discussion should also lead students to conclude that non-standard units are most efficient when the units tile.

The shape on BLM 4.SS.10 can be covered by the following:

- 7 hexagons
- 14 trapezoids
- 21 rhombi
- 42 triangles

- **Using Centimetre Cubes:** Once students understand the concept of area and realize the issues of using non-standard units, they can use standard units to measure. Marian Small notes that some students may be confused when area is described in terms of square units. Students need to understand that these squares can be dissected and rearranged to form many different shapes, all representing the same area (Small, *Grades K–3*).

- **Recording Area Measures in Standard Units:** To transition to standard measures, introduce square centimetres by using base-10 blocks or Cuisenaire rods (smallest unit) to measure because students can cover a shape with cubes and count to measure the area. These blocks measure 1 cm on each side. Have students measure and record different objects around the room with the centimetre cubes. After students have measured and recorded items, ask them how they recorded the measurements. Show how to record area measurements in square units. Spell out the measurement ("5 square centimetres") at first and then indicate the measurement with the exponent two ("5 $cm^2$"), which indicates that the units have two dimensions.

BLM 4.SS.3.3

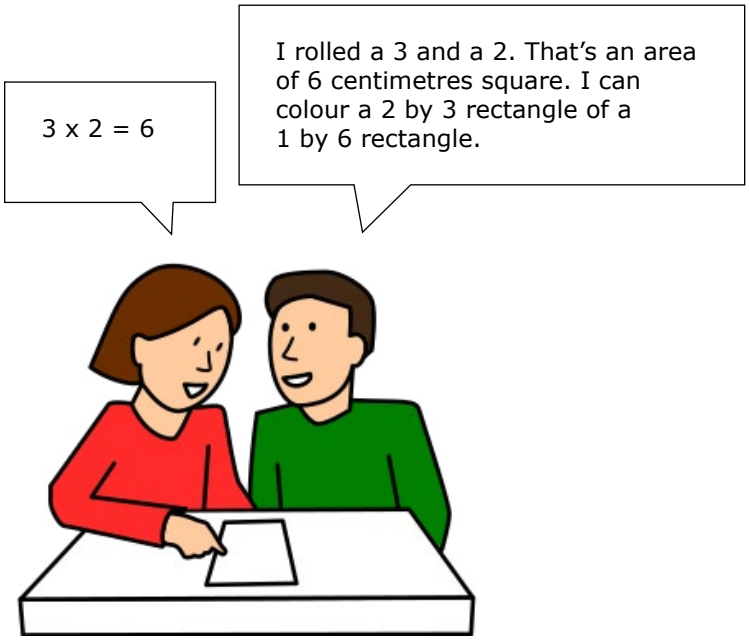
- **Using Grid Paper:** Introduce students to centimetre grid paper, such as BLM 4.SS.3.3. Have them explore how it can be used to measure area. Students may use centimetre cubes to compare it with the grid paper. Have the students use a centimetre ruler to measure the side of the centimetre grid paper to verify that each square is 1 $cm^2$. Have students practise measuring different classroom objects using the ruler. The grid paper can be copied onto transparency film to measure irregular objects more easily.

- **Estimating Area:** Ask students what they would do if they did not have a measuring tool to measure the area of an object. Facilitate the discussion toward how using referents could be a solution. Ask students what they could use as a referent for 1 $cm^2$ and have them explain their thinking. Using the width of a little finger can be used as a referent for about 1 cm. Gather a few different books and have the students estimate the area of the covers using the referent and then have them check by finding the area of the book covers.

- **Square Metres:** Introduce the concept that square metres can be used for measuring area. Ask students what items could be used to measure square metres. Discuss possible referents for 1 $m^2$ after marking off 1 $m^2$ on the floor using masking tape. This visual allows students to see what 1 $m^2$ looks like. Have students use their referents to estimate the area of a large section of a wall or floor. Use a square piece of paper that measures 1 $m^2$ to check the estimates. Have students practise measuring and recording using a metre stick.

BLM 4.SS.3.4

- **Cover the Area Game:** Students' understanding of area will deepen when they become aware that squares can be dissected and rearranged to form different shapes, all representing the same area. BLM 4.SS.3.4, *Cover the Area Game,* provides students with an opportunity to discover that shapes with the same area do not have to be congruent. The game also helps students make connections between arrays and multiplication. The game has students creating rectangles arranged in an array. Initially, students may count all the squares in the array, before they begin to understand that the total number of squares can be found by multiplying the number of squares in a row by the number of squares in a column. After the students play the game, a number discussion should be initiated. Ensure that students see how different rectangles were created but the area was the same.



- **Square Centimetres or Metres?** Provide students with centimetre-grid paper for measuring square centimetre units. Ask pairs of student to list four items that should be measured in square centimetres and four items that should be measured in square metres. Have students exchange lists and then estimate, measure, record, and order the items on each list.

**Assessing Understanding: Paper-and-Pencil Task or Interview**

Have students construct all the rectangles that have an area of 36 $cm^2$. Use grid paper to record each rectangle's dimensions.

Real life problem to solve:

Zeta wants a rectangular garden that is 24 $m^2$ for her backyard. What are the different gardens that she could have if the lengths and widths are whole numbers? How do you know that you have included all the possible garden plots?

The student

- ❒ names all the areas
- ❒ applies an understanding of patterns to solve the problem

**Designing a Playground**

**Organization:**

- Groups of two or three

**Materials:**

- 1-cm grid paper
- rulers, pencil crayons

**Context:**

The school has decided to build a new playground.

Students have been invited to submit proposals to the principal. Proposals must include a design of the playground area. The playground must consider the following guidelines:

- The playground must be in the shape of a rectangle.
- There must be three to five sections for equipment with space in between so that students are safe.
- Each structure should be different from the others.

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

Each proposal should include the following:

- the plan for the playground, drawn on grid paper with each drawing on the plan labelled
- an explanation that the area of one grid square represents 1 $m^2$
- the equipment areas shown with area in $m^2$
- a written explanation of the plan
- an attached explanation of how each area was calculated

Look for an understanding of

- ❒ measurement vocabulary
- ❒ area as the amount of space a shape covers
- ❒ correct area calculations
- ❒ correct recording of measurements
- ❒ metric measurements

**Notes**

# Grade 4: Shape and Space (Geometry) (4.SS.4, 4.SS.5)

**Enduring Understandings:**

Geometric shapes and objects can be classified by attributes.

Objects can be described and compared using geometric attributes.

Any 2-D shape or 3-D object can be created by combining and dissecting other shapes.

**Essential Questions:**

What are the attributes of a shape or object?

What are ways shapes or objects can be sorted?

How can a shape can be dissected and rearranged into other shapes to help describe the properties of the shape?

| Specific Learning Outcome(s): | Achievement Indicators: |
|---|---|
| **4.SS.4** Solve problems involving 2-D shapes and 3-D objects. [C, CN, PS, R, V] | ➛ Fill an outline with 2-D shapes (e.g., tangram pieces, pentominoes, or polygons).<br>➛ Reproduce 2-D shapes from drawings, real objects (tables, houses, letters of the alphabet), or attributes on geoboards.<br>➛ Reproduce a structure using 3-D objects (e.g., cubes, 3-D pentominoes). |
| **4.SS.5** Describe and construct rectangular and triangular prisms. [C, CN, R, V] | ➛ Identify and name common attributes of rectangular prisms from sets of rectangular prisms.<br>➛ Identify and name common attributes of triangular prisms from sets of triangular prisms.<br>➛ Sort a set of rectangular and triangular prisms using the shape of the base.<br>➛ Construct and describe a model of rectangular and triangular prisms using materials such as pattern blocks or modelling clay.<br>➛ Construct rectangular prisms from their nets.<br>➛ Construct triangular prisms from their nets.<br>➛ Identify examples of rectangular and triangular prisms found in the environment. |

## Prior Knowledge

Students may have had experience

- describing 3-D objects according to the shape of faces, and the number of edges and vertices
- sorting regular and irregular polygons according to the number of sides, including triangles, quadrilaterals, pentagons, hexagons, and octagons

## Background Information

As students progress with their understanding of geometric thinking, the goal is to have them be aware of geometric properties of two-dimensional shapes and three-dimensional objects. For example, students can see a rectangle and recognize it as a rectangle, but they should know the specific attributes that make it a rectangle. Students should know that rectangles have four sides in which opposite sides are of equal length and that rectangles have four square corners.

Students will learn about geometric properties as they handle and manipulate objects. Specific Learning Outcome 4.SS.4 encourages students to describe and reproduce two-dimensional shapes and three-dimensional objects. It also allows students to investigate the results of composing and decomposing shapes to develop spatial sense. Van de Walle, Karp, Lovin, and Bay-Williams describe spatial sense as "an intuition about shapes and the relationships among shapes. Spatial sense includes the ability to mentally visualize objects and spatial relationships, including being able to turn objects around in one's mind. It also includes a familiarity with geometric descriptions of objects and position" (Van de Walle, Karp, Lovin, and Bay-Williams 345).

Providing students the opportunity to solve puzzles using shapes will build an understanding of the shapes and foster their spatial and problem-solving skills.

Pierre van Hiele and Dina van Hiele-Geldof (cited in Van de Wall, Karp, Lovin, and Bay-Williams 346–351), mathematics teachers from the Netherlands in the 1950s, researched the development of geometrical thinking. Through their research they identified five sequential levels of geometric thought. Two of the levels are listed on the following page. Most Grade 4 students will be at level 0 or 1.

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 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

**Level 1: Analysis** (Some students may be at this stage.)

At this level students begin to be able to identify the properties of shapes. They use appropriate geometric vocabulary related to properties. They are able to move beyond less important features such as size or orientation in order to sort and classify shapes. They start to describe the relationship between shapes and their properties.

Suggestions for instruction at this level include

- focusing on properties (defining, measuring, observing, or changing) by using concrete or virtual models
- problem solving involving shapes
- classifying shapes based on their properties

**Terminology**

**3-D Terms:**

**3-D objects:** An object that has length, width, and height; also called a solid object (e.g., prism, pyramid, cylinder, cone).

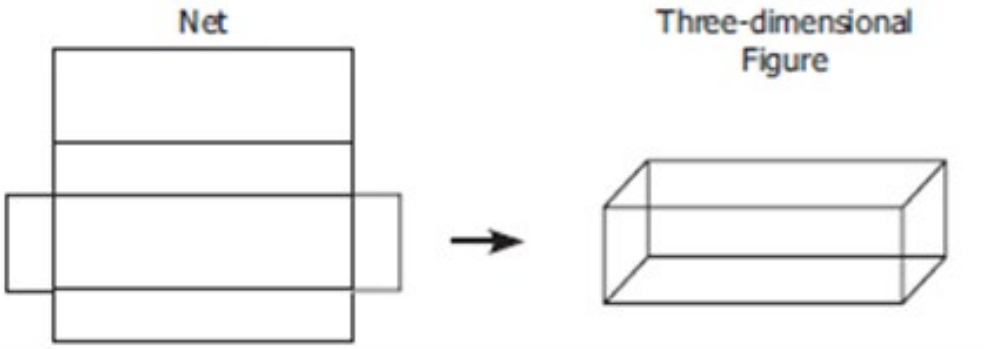
**Base:** A particular side or face of a geometric figure.

**Congruent:** Two figures that have the same shape and size.

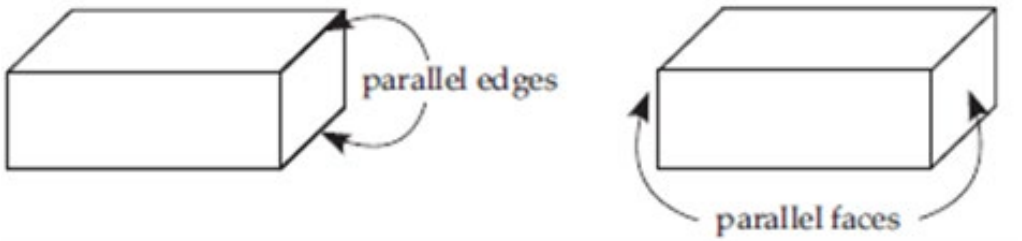
**Edge:** The line segment where two plane faces of a solid figure meet.

**Face:** A flat surface of a solid.

**Net:** The 2-D set of polygons of which a 3-D object is composed.



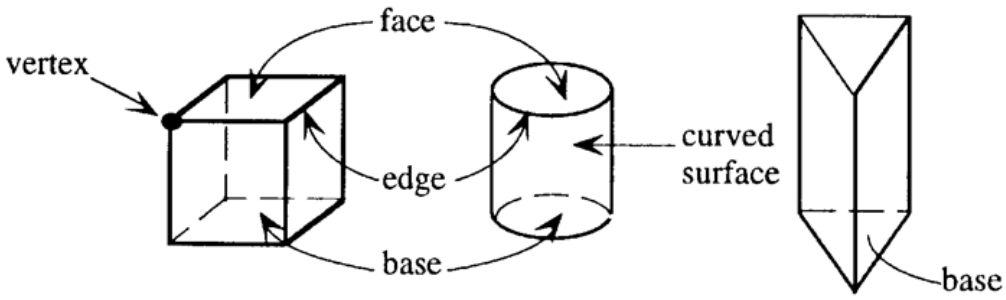

**Parallel:** Faces or edges of a 3-D object that never intersect; they are equidistant (equal distance) from each other.




**Prism:** A 3-D figure (solid) that has two congruent and parallel faces that are polygons (the bases); the remaining faces are parallelograms.

**Pyramid:** A polyhedron whose base is a polygon and whose lateral faces are triangles that share a common vertex.

**Vertex, Vertices:** The common point where three or more edges of a 3-D solid meet. Note: A cone has an **apex,** but it is often referred to as a vertex.




**Note:** Cones and spheres have curved surfaces (i.e., a cone has one face and one curved surface).

**2-D Terms:**

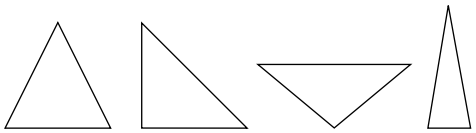
**Polygon:** A closed plane figure formed by three or more line segments.

**Regular polygon:** A polygon in which all sides and all angles are congruent.

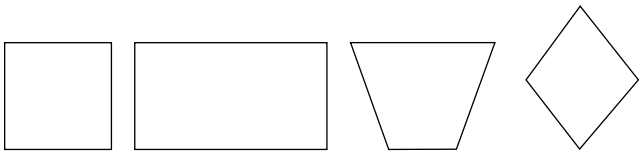
**Irregular polygon:** A polygon whose sides and angles are not all congruent.

**Polygon Names:** Note: Regular polygons are shown first.

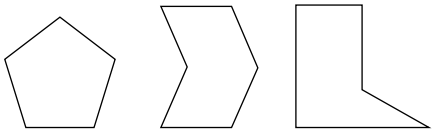
3 sides—triangle



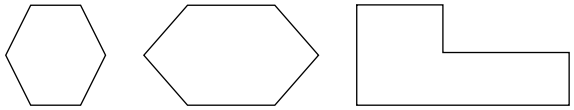
4 sides—quadrilateral



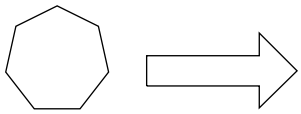
5 sides—pentagon



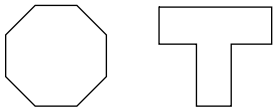
6 sides—hexagon



7 sides—heptagon



8 sides—octagon



## MATHEMATICAL LANGUAGE

cube
sphere
cone
cylinder
prism
pyramid
face
edge
vertex
vertices
curved surface
skeleton
polygon
regular polygon
irregular polygon
triangle
quadrilateral
pentagon
hexagon
heptagon
octagon
three-dimensional
two-dimensional
attribute
property
sides
shape
object

## Learning Experiences

### Assessing Prior Knowledge: Journal/Notebook Entry

- How are 2-D shapes and 3-D objects related?
- Draw five different polygons and name them.
- Draw five different hexagons.

The student

- ❒ identifies how 2-D shapes and 3-D objects are related (3-D objects are made up of 2-D shapes. 3-D objects get their names from their 2-D shaped bases.)
- ❒ correctly draws and names polygons
- ❒ is able to draw five different hexagons and to recognize that a hexagon can be regular or irregular

- **Fill an outline with 2-D shapes (e.g., tangram pieces, pentominoes, or polygons).**
- **Reproduce 2-D shapes from drawings, real objects (e.g., tables, houses, letters of the alphabet), or attributes on geoboards.**

### Suggestions for Instruction

- **Puzzle Outlines:** Different manipulatives can be used to fill in shapes of different puzzles. Sandra Ball and Carole Fullerton have created different puzzles for pattern blocks, tangrams, pentominoes, and Cuisenaire rods. Find their puzzles by downloading a free copy of *Daily Math Investigations: Meaningful Math Routines: Alternatives to Calendar Designed to Keep Your Students Engaged, Thinking and Reasoning Mathematically!* from the following site: https://mindfull.wordpress.com/free-downloads-2/daily-math-investigations-k-3/.

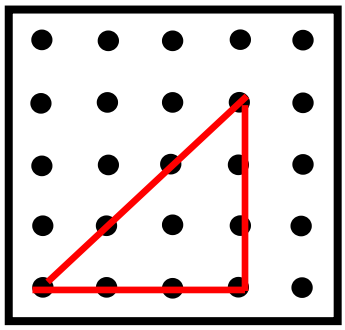
  Questions that can be used during the learning experiences include the following:

  - What did you notice about the puzzle?
  - What strategy did you use?
  - Which shapes were used to fill in the puzzle?
  - Could other shapes fit into the puzzle?

- There are many ready-made commercial resources that contain puzzles of pattern blocks, tangrams, and pentominoes.
  - **Pattern Block Puzzles:** Use pattern blocks to fill in shapes of puzzles. Have students match blocks to the outlines. Encourage them complete the puzzles in more than one way. Discuss with the students the relationships between the pieces. Have students complete the same puzzle outline using the greatest number of pattern blocks and the smallest number of pattern blocks.
  - **Tangram Puzzles:** Use a complete set of seven tangram pieces and puzzles to get students to match pieces to the outlines. Encourage them to complete the puzzles in different ways. Find more tangram puzzles at the following websites:
    - Tangram Channel: www.tangram-channel.com/tangram-puzzles/
    - Activity Village: www.activityvillage.co.uk/tangrams
    - NRICH: http://nrich.maths.org/public/leg.php?code=5044
  - **Pentomino Puzzles:** Use a complete set of 12 pentomino shapes and puzzles of the shapes. Have students match pieces to the outlines.
  - **Cuisenaire Matching Tasks:** Use Cuisenaire rods and puzzles of pictures created from the rods. Have students match rods to the outlines. Encourage them to complete the puzzles in more than one way. Have students calculate the value of the puzzle as an extension activity and make connections to number operations and patterns.
- **Making Puzzles:** Have children create their own puzzles with different pattern blocks, tangrams, pentominoes, and Cuisenaire rods. Have children outline their pictures and exchange with a partner. Each partner will attempt to fill in the other's puzzle.
- **Grandfather Tang's Story:** Read *Grandfather Tang's Story: A Tale Told with Tangrams* by Anne Tompert, illustrated by Robert Andrew Parker, to the students. The story uses tangrams to illustrate the story a grandfather tells his granddaughter. Have students recreate the tangram creatures found throughout the book. Have students assemble the tangram pieces to replicate shapes from the book and trace around the outside of the figures. Have them fill in the shape with black marker. The tracings can be placed in a math centre.

BLM 4.SS.4.1

- **Geoboard Copy:** Create 2-D shapes on a geoboard or show different pictures of objects. Have students copy the shape with their own geoboards. Start with using one band and then progress the activity by using more bands to create complex shapes. Have students create different shapes on BLM 4.SS.4.1, and create a centre using the cards (Van de Walle, Karp, Lovin, and Bay-Williams 357).



**Assessing Understanding (2-D Shapes): Paper-and-Pencil Task or Interview**

**Seven Ways to Make a Hexagon:** Have students find as many of the seven combinations as they can to cover the outline of a hexagon pattern block and record how they know they have all the shapes.

The student

- ❒ uses the correct math vocabulary
- ❒ records solutions accurately
- ❒ applies an understanding of patterns to solve the problem

- **Reproduce a structure using 3-D objects (e.g., cubes, 3-D pentominoes).**

## Suggestions for Instruction

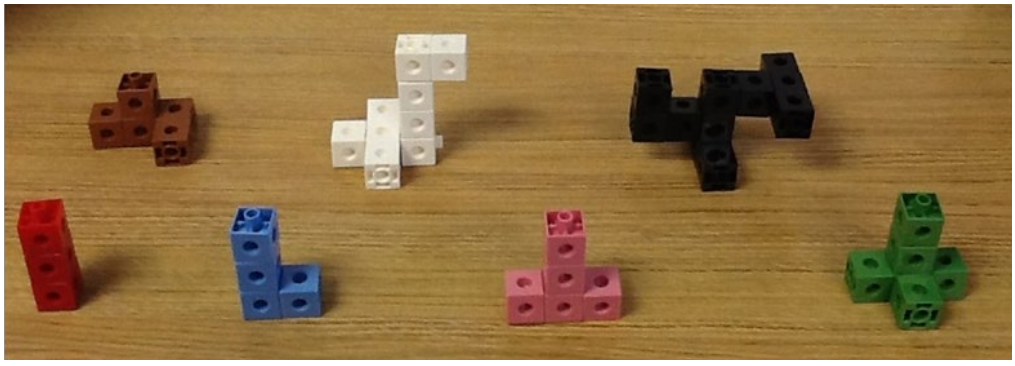
When students combine, separate, and transform shapes, they are investigating relationships among the shapes. When students reproduce an object, they need to think about how the whole object looks and about how the parts relate to each other and to the whole.

In producing a 3-D object, students must do the following:

- "see" the component parts of the whole 3-D object
- produce each component part (in the correct shape and size, either full or scaled)
- put the component parts together in the correct relationship to each other and in the correct proximity and orientation of the whole 3-D object

As stated in *First Steps in Mathematics: Geometry and Space,* "Students need to analyze the component parts that form the object—their shape, size, and placement, considering how the components fit and hold together. They will need to learn from their mistakes by observing what goes wrong when insufficient attention is paid to details of shape, size, and placement" (Western Australian Minister for Education 73).

- **Building Objects:** Show different pictures of objects such as vehicles, playground equipment, bikes, and buildings. In pairs, have students build the pictures using cubes.
- **Build the Structure:** Ask students to build a structure using between four and six blocks. Have students sit in pairs with a file folder separating each of the students' structures. Have one student explain his/her structure while the other recreates the speaker's structure without looking. Encourage students to use correct math vocabulary.
- **3-D Pentominoes Build:** Show students different 3-D pentominoes and have them reproduce them using cubes. *3-D Pentomino Puzzle* gives different representations for 3-D pentominoes and is available at the following address: https://www.learningresources.com/text/pdf/2240_TG.pdf.
- **Cube Challenge:** Show students different arrangements of structures made from cubes, one at a time. The picture below shows examples. Ask students to build the structure. Observe to see if the students build the structures in sections and if they are able to recognize when their structure is different than the arrangement being displayed. This learning experience provides an opportunity for students to discover that objects are the same despite differences in their orientations.



- **Identify and name common attributes of rectangular prisms from sets of rectangular prisms.**
- **Identify and name common attributes of triangular prisms from sets of triangular prisms.**
- **Identify examples of rectangular and triangular prisms found in the environment.**
- **Construct and describe a model of rectangular and triangular prisms using materials such as pattern blocks or modelling clay.**

## Suggestions for Instruction

A prism is a 3-D figure (solid) that has two congruent and parallel faces that are polygons (the bases); the remaining faces are parallelograms. The bases take the shape of any polygon. Prisms can be classified in terms of the shape of their base. In Grade 4 it is not expected to use all the formal geometric language. However, it is good to seize opportunities to model correct language. For example, the words *congruent* and *parallel* can be introduced to students. In Grade 4, students will be describing and constructing rectangular and triangular prisms and identifying examples of them in the environment.

Prisms can be built by vertically or horizontally piling different blocks together. Have students stack pattern blocks or attribute blocks to make rectangular prisms and triangular prisms. Discuss the attributes of the objects. Then have students construct the prisms using modelling clay.

- **Prisms:** Provide students with a variety of rectangular and triangular prisms. Square prisms fall into the category of rectangular prisms because a square is a rectangle. Provide many variations of each type of object to the students. Students need to see narrow, wide, tall, and short prisms so they can recognize any type of prism. Have students sort the prisms. Engage in a conversation about their attributes. Have students compare the prisms. Comparisons can lead to discussions about differences and similarities. Students can make anchor charts of the prisms, recording the following 3-D attributes:
  - square or triangle faces
  - number of faces or edges
  - identical (congruent) faces
  - number of vertices

- **Wanted Posters:** Have students create wanted posters of a rectangular or triangular prism. Have them list the attributes and name environmental objects that look like the object.
- **Prisms in the Environment:** Have students find examples of prisms in the classroom, school, playground, community, and their homes. If possible, have students take pictures of the prisms and then they can be made into an individual or a class book. Each picture should be accompanied by a description of where the prism was found along with the correct name for the prism.

- **Construct rectangular prisms from their nets.**
- **Construct triangular prisms from their nets.**

## Suggestions for Instruction

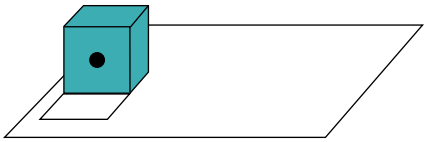
- **Skeletons:** Make a skeleton of a rectangular and triangular prism. A skeleton is an open 3-D figure constructed from materials (e.g., straws, pipe cleaners). Constructing a skeleton before constructing nets can help students see the vertices and edges that make up a prism.
- **Creating a Net by Rolling and Tracing:** A net is the 2-D set of polygons of which a 3-D object is composed.

  A net can be folded and assembled to recreate a 3-D object. Nets focus on the faces that make up a 3-D object and how they fit together. Students must come to realize there may be different nets that make a single object. The faces of a net can be connected in various ways to make an object. Ensure that the drawing is correct by having the students cut the tracing to see if they can make a prism. Marian Small outlines an activity in which students roll an object and trace its faces to create a net (Small, *Grades K–3* 72).

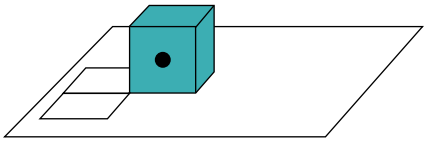
Creating a Net by Rolling and Tracing

Step 1: Trace one face and mark it with a dot.

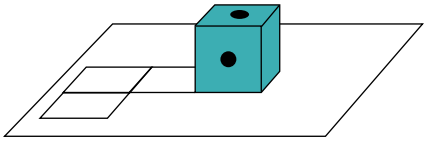
Step 2: Roll onto another face and trace it, then mark it with a dot.



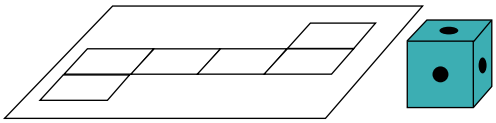
Step 3: Roll onto another face and trace it, then mark it with a dot.



Step 4: Roll onto another face and trace it, then mark it with a dot.



Step 5 and 6: Continue rolling, tracing, and marking faces until you have traced all 6 faces. Make sure that the arrangement of rectangles will form a net. Cut out the prism to see if it makes the 3-D object.



BLM 4.SS.5.1

- **Nets:** Provide nets of rectangular and triangular prisms, BLM 4.SS.5.1, for students and ask them to identify the 3-D object. Have them verify by folding.
- **Air Nets:** NRICH (University of Cambridge) presents videos at http://nrich.maths.org/6307 showing nets being created from Polydron pieces. Watch the videos about rectangular and triangular prisms. Ask students to do the following:
  - Predict what object the net will create.
  - Predict whether or not the net will fold into a 3-D object.

**Assessing Understanding: Paper-and-Pencil Task or Interview**

Ask students, "How are rectangular and triangular prisms alike?"

The student is able to explain that

- ❒ both rectangular and triangular prisms are 3-D objects
- ❒ both rectangular and triangular prisms have two polygon faces (bases) that are the same size and shape (congruent) as their opposite sides
- ❒ all non-base faces of prisms are rectangles that touch the bases.

# Grade 4: Shape and Space (Geometry) (4.SS.6)

**Enduring Understandings:**

Geometric shapes and objects can be classified by attributes.

Objects can be described and compared using geometric attributes.

Any 2-D shape or 3-D object can be created by combining and dissecting other shapes.

A shape or picture is symmetrical if it can be divided into two congruent halves, each part a reflection of the other.

**Essential Questions:**

What are the characteristics of symmetrical shapes?

How do you identify lines of symmetry?

Are some shapes more symmetrical than others?

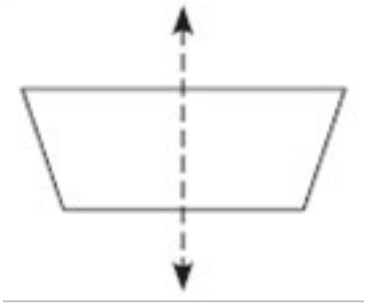
| Specific Learning Outcome(s): | Achievement Indicators: |
|---|---|
| **4.SS.6** Demonstrate an understanding of line symmetry by<br>■ identifying symmetrical 2-D shapes<br>■ creating symmetrical 2-D shapes<br>■ drawing one or more lines of symmetry in a 2-D shape<br>[C, CN, V] | ➛ Identify the characteristics of symmetrical and non-symmetrical 2-D shapes.<br>➛ Sort a set of 2-D shapes as symmetrical and non-symmetrical.<br>➛ Complete a symmetrical 2-D shape, half the shape, and its line of symmetry.<br>➛ Identify lines of symmetry of a set of 2-D shapes, and explain why each shape is symmetrical.<br>➛ Determine whether or not a 2-D shape is symmetrical by using a Mira or by folding and superimposing.<br>➛ Create a symmetrical shape with or without manipulatives.<br>➛ Provide examples of symmetrical shapes found in the environment, and identify the line(s) of symmetry.<br>➛ Sort a set of 2-D shapes as those that have no lines of symmetry, one line of symmetry, or more than one line of symmetry. |

## Prior Knowledge

Students will be drawing on their previous knowledge of 2-D shapes to assist them in their understanding of symmetry.

## Background Information

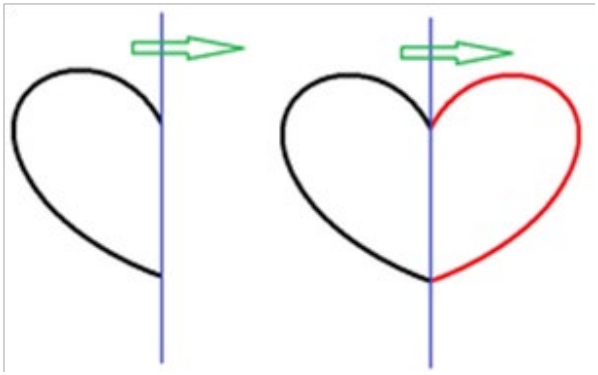
**Symmetry** is the property of having the same size and shape across a dividing line or around a point. If a shape or image can be folded so that the two halves match exactly, then the shape or figure has line symmetry. The fold line is actually a line of symmetry or line of reflection.



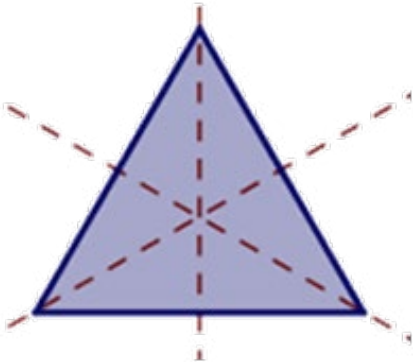
A **line of symmetry** is a line that divides a figure into two congruent parts so that they can be matched by folding the shape in half. The two parts are mirror images of each other.

A shape is **symmetrical** when two sides of a shape are balanced about a line or point, when two sides of a shape are mirror images, or when a shape has one or more lines of symmetry.

Students will be exploring the attribute of line symmetry with 2-D shapes and figures. Folding a shape to see if one half exactly matches the other is a way to find out if a shape has symmetry. If it has symmetry the shape is symmetrical. Two-dimensional symmetrical shapes can be divided along one or more lines of symmetry.



1 line of symmetry



3 lines of symmetry

Students will find that the more sides there on a regular polygon, the more lines of symmetry there will be. Also, the number of lines of symmetry on a regular polygon is equal to the number of vertices of that polygon.

## Learning Experiences

- **Identify the characteristics of symmetrical and non-symmetrical 2-D shapes.**
- **Sort a set of 2-D shapes as symmetrical and non-symmetrical.**
- **Complete a symmetrical 2-D shape, half the shape, and its line of symmetry.**
- **Identify lines of symmetry of a set of 2-D shapes, and explain why each shape is symmetrical.**
- **Determine whether or not a 2-D shape is symmetrical by using a Mira or by folding and superimposing.**
- **Create a symmetrical shape with or without manipulatives.**
- **Provide examples of symmetrical shapes found in the environment, and identify the line(s) of symmetry.**
- **Sort a set of 2-D shapes as those that have no lines of symmetry, one line of symmetry, or more than one line of symmetry.**

### Suggestions for Instruction

- Provide students opportunities to explore symmetry through creative explorations.
  - Have students fold a paper in half, open and drop paint on one half, then fold to "print." Have students unfold the paper and discuss the attributes of the image.
  - Fold a paper in half, open and draw half a shape with heavy-black crayon lines. Other dark crayons may work as well. Refold and press firmly on the crayon lines to transfer them to the other half. Have students open and retrace the lighter "print" if needed.
  - Questions to explore with the students:
    - What do you notice about the reflection?
    - What do you notice about images?
    - How are the images alike? Is there a relationship between the two images?

- **Let's Fly a Kite:** Read the story, *Let's Fly a Kite* by Stuart J. Murphy, illustrated by Brian Floca. Then demonstrate the use of a plastic mirror to show how students can check for symmetry without cutting or folding the pictures in the book.

BLM 4.SS.6.1

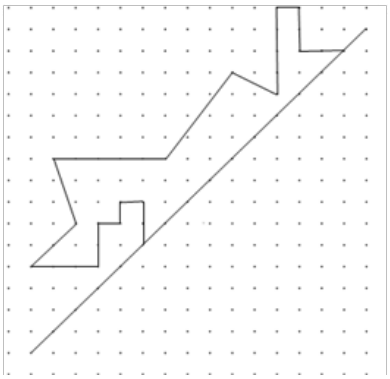
- **Mirrors and Miras:** Supply mirrors or Miras for students to sort upper-case alphabet letters (BLM 4.SS.6.1) into two groups—symmetrical and not symmetrical.

- **Extension:** Have students sort the letters into three groups—no lines of symmetry, one line of symmetry, more than one line symmetry.

- **Symmetry through the Year:** During holiday times, have students cut holiday symbols such as hearts, shamrocks, and snowflakes by folding paper and cutting symmetrical figures. The symbols can be reused for classroom decorations.
- **Complete the Picture:** Provide students with pictures that show half of the image. Have them place a Mira along a line of symmetry. Students will use the reflection to draw the other half of the picture. Have students test the accuracy by reflecting the drawn half onto the original side. Ask students for another way to check the reflection (cut out the shape and fold).

BLM 4.SS.6.2

- **Picture Creation:** Using dot paper (BLM 4.SS.6.2), have students draw a line (horizontally, vertically, or diagonally) though several dots. Have students make a design or picture completely on one side of the line. Have students make a mirror image of their design on the other side of the line. Students can even exchange designs and make the mirror image of each other's picture. Have students check their work with a mirror.



- Have students discuss examples of symmetrical shapes in their everyday life.

**Assessing Understanding: Paper-and-Pencil Task or Interview**

Ask students to identify and record two 2-D shapes that have line symmetry. Have them show where the lines of symmetry are. Have them explain why the shapes are symmetrical.

The student

- ❒ makes symmetrical shapes
- ❒ justifies why the shapes are symmetrical
- ❒ identifies the lines of symmetry

BLM 4.SS.6.3

Have students fill out BLM 4.SS.6.3, *The Frayer Model,* to show their understanding of line symmetry.

Ask students, "How would you define symmetry to someone who did not know what it is?"

The student

- ❒ states that you can fold the shape on top of itself, or a shape can be folded so that the two halves match exactly, or gives a similar response
- ❒ gives examples and non-examples of symmetrical shapes or figures