

## Mathematics in Grade 4 Lesson Learned 6

### Measurement

Students are expected to build conceptual understanding of what it means to measure with a ruler. Emphasis should be placed on counting the intervals between the numbers, rather than looking at the number on the ruler that is aligned with the end of the object. Students also need to use a ruler to measure the length of a pencil or other objects with and without using zero as the starting point. Students need to recognize which mass unit (gram or kilogram) is appropriate for measuring and comparing the mass of a specific item. Students need to be able to explain that perimeter is the distance around a shape or the length of the boundary of an enclosed region. Students need to find the perimeter of many different regular, irregular, and composite shapes, before being introduced to questions in pictorial form. Students need to work with perimeter in application and analysis questions.

#### A. What conclusions can be drawn from the Nova Scotia Assessment: Mathematics in Grade 4?

We noticed that students did very well when presented with questions related to direct measure, time referents, and approximate measure when using personal referents. For example, students were able to identify how many centimetres are in one metre (Knowledge question). They were also able to solve a given problem involving the number of seconds in a minute, the number of minutes in an hour, and the number of hours in a day (Knowledge question).

Students were able to use their personal referents for 1 g and 1 kg to estimate the mass of common objects, such as a bag of sugar or a paper clip (Application question). Students also did well when estimating the length or height of an object using personal referents. For example, students used the height of a doorknob from the floor as a personal referent for 1 m (Application question).

Having these personal referents helps students visualize measurements and estimate more accurately. Personal referents also help students identify the units required for specific measurements.

A big idea developed in Grade 3 is perimeter. Students appeared to not understand the concept of perimeter even though a definition was given in parentheses in a question on the assessment. Students need to be able to explain that perimeter is the distance around a shape or the length of the boundary of an enclosed region.

#### B. Do students have any misconceptions or errors in their thinking?

A common error that many students make is the placement of the ruler when measuring an object. This may indicate that they do not understand that they are counting the intervals between the numbers to determine length. Some students fail to consider the gap between the end of the ruler and the zero mark. Other students may begin to measure at other points on a ruler, other than the 0 cm mark when they first start to use a standard measurement tool such as a centimetre ruler. Some students ignore the 0 cm mark and begin at the 1 cm mark. This may indicate that students do not realize that the scale of the ruler begins at 0 cm, especially if it is not labelled at the beginning of the ruler. Note however, that some students may start at 1 on the ruler but still use the ruler accurately by taking this into consideration as shown in the picture found below. The pencil being measured starting at the 0 cm mark measures 4 cm. The pencil being measured starting at 1 cm and ends at 5 cm, still measures 4 cm.



Students have misconceptions related to estimating mass and comparing the kilogram and the gram. Students need to recognize which mass unit (kilogram or gram) is appropriate for measuring and comparing the mass of a specific item. Students have difficulty matching an item with its estimated mass. When you measure how heavy an object is, you're measuring its mass. Students may not understand that mass and size are not necessarily related. Different sized objects can have the same mass, while objects of the same size can have different masses.

Another common misconception that students have is related to perimeter and area. Some students have the misconception that perimeter and area of an object are always the same measures. Students should recognize that area and perimeter are independent of one another. Students often do not make the distinction between area and perimeter and do not understand when to use each one in a problem. They may calculate the area instead of the perimeter or vice versa. Others think that perimeter and area are interchangeable. This is seen when students are finding the perimeter of many different regular, irregular, and composite shapes drawn on 1 cm paper. They find it difficult to count the units along the perimeter.

The student result of the 2016–2017 Nova Scotia Assessment Mathematics in Grade 4 shows the following data:

- 64% of the students were not able to determine the perimeter of a regular hexagon.
- 73% of the students were not able to determine the length of a pen using a ruler.

### C. What are the next steps in instruction for the class and for individual students?

**Standard Units:** Working with standard units is integral to students' understanding of measurement. Students may start using standard units to measure length when they realize that non-standard units mean different things to different people. For example, if someone says a book is 15 cm long, everyone knows how long that is, but to say the book is 15 cards long would be more difficult to interpret. Students need to develop a familiarity with standard units and explore the relationship between them.

Students begin to use a standard tool to measure length in Mathematics 3. They learn about two basic standard units of length—centimetre and metre. It is valuable to initially use simpler rulers that are created by the students. Then, they should move on to tools that are easy for them to read. Students should use rulers (or the side of the ruler) that show only numbered centimetres and not millimetres. Students should identify objects from around the classroom that would be an appropriate referent for a centimetre or a metre; for example, a pencil, a garbage can, a teacher's desk, or a glue stick.

**Measuring using a Ruler:** When students begin to use rulers to measure, it is important for students to line up the 0 mark with one end of the shape being measured. Emphasis should be placed on counting the intervals between the numbers, rather than looking at the number on the ruler that is aligned with the end of the object. Lining up small cubes from base-ten materials along the ruler will demonstrate that the numbers on the ruler correspond to the number of small cubes, starting at 0. Observe how students use a ruler to measure a shape that is longer than the ruler. Show students how to measure something that is longer than a ruler by marking, recording, and starting again.

Using a centimetre ruler, students should measure the length, width, or height of a given 3-D object in the classroom, such as a lunch box, their desk, or a cereal box. Students can record their measurements using both the number and the measurement unit; for example, 3 cm or 3 centimetres. Ensure students are clear about the distance they should be measuring.

Instruction should continue to support students in learning to use rulers accurately. A strategy often used to help students is to break up plastic rulers. Give a piece of broken ruler to each student and ask them to measure items in the classroom. Observe how they attempt to measure items, especially if there is not a familiar starting point for them, such as 0 cm or 1 cm on their piece of ruler.

Another important strategy to help students learn to measure accurately is to encourage them to estimate measurements before actually verifying them using a measurement tool.

**Mass and Weight:** The terms mass and weight are similar, but they are not the same. Weight measures how heavy an object is and depends upon gravity, so it will vary with height above sea level. On the other hand, mass measures the amount of matter in an object and will be the same at all heights above sea level. As with all measurement units, it is important that students have a personal referent for a gram and a kilogram. Students should recognize which mass unit (gram or kilogram) is appropriate for measuring the mass of a specific item. It is helpful for students to investigate how everyday items, such as food items, are measured. Include items that are small and dense, such as a golf ball, as well as those that are large and hollow or porous, such as a beach ball. Students need to understand that grams are used to measure very light objects and kilograms are more appropriate units for heavier objects.

Using their understanding of a kilogram, ask students to brainstorm items that may have a mass of 1 gram. They may also use a small base-ten cube as a personal referent of a gram. You may wish to provide students with items such as a raisin, bean seed, jelly bean, or a paper clip, to conceptualize the sense of how a gram feels.

It would be beneficial for students to have an opportunity to make a kilogram mass of their own. Provide students with materials such as sand, flour, sugar, and small cubes from base-ten materials to fill a container until it exactly balances with a 1 kg mass on a balance scale. Using this kilogram container, they can now compare its mass to items in the classroom to help them find a personal referent for 1 kg.

Using objects from the classroom, for example a counter, a raisin, a paper clip, a textbook, a sneaker, or a lunch box, ask students to identify whether the object is an appropriate referent for a gram or a kilogram. Once students have established a personal referent for 1 g and 1 kg, they can now use their referents to estimate the mass of common objects such as an eraser, an apple, a juice box, or a textbook, or to estimate whether an object is heavier or lighter than 1 kg.

Estimating mass is more difficult than estimating other measures, as the object's size and shape is not directly related to its mass. A strategy often used to help students with this misconception is to encourage them to use the known mass of one object to estimate the mass of another. For example, a tennis ball and an orange are about the same size, but the orange is much heavier than a tennis ball.

It is important for students to know that 1000 grams is equal to a kilogram. Model for students how 1000 g is equal to 1 kg using a balance scale; use food items of various benchmark masses, such as 2 bags of 500 g, 4 boxes of 250 g, or a pre-counted bag of 1000 jellybeans.

**Perimeter:** Students learn perimeter best when they can make connections to real life examples. Ideas include fencing a yard, and actually measuring the perimeter of the classroom or gym using metre sticks.

It is important that students have many opportunities to find the perimeter of many different regular, irregular, and shapes concretely before being introduced to pictorial forms. Pentominoes may be used to illustrate measuring and recording the perimeter of a given composite shape. Pentominoes are shapes each made up of five squares, all of which must have at least one side matching up with the side of another.

In addition to composite shapes with straight sides, it is important to expose students to other shapes such as their handprint. Working with a partner, ask students to trace around their closed hand. Using string they can outline their handprint and then cut the string to determine the perimeter of their handprint by measuring the length of the string with their ruler. Again, students need to be able to explain the strategies they used for finding perimeter as they proceed.

In the early grades, students should explore their own methods for determining the perimeter of a shape and should not develop or follow a formula for calculating perimeter. For example, provide students with various regular and irregular polygons (e.g., squares, rectangles, and triangles), some string, and a ruler. Small groups of students should be asked to find the perimeter of the various regular and irregular polygons in a variety of ways. Some may use the string, while others go directly to measuring the sides with the ruler.

Students need to draw more than one shape for the same given perimeter. Students may use a geo-board or centimetre grid paper to explore various shapes with the same perimeter. They may explore various rectangles before exploring other shapes.

Students should be given opportunities to construct shapes of a given perimeter. Discuss with students that when constructing shapes for a given perimeter, they must remember that their shapes should be completely enclosed. It would be easier for students to begin their constructions drawing rectangles using centimetre grid paper and horizontal and vertical lines only.

**D. What are the most appropriate methods and activities for assessing student learning?**

Below are some sample questions related to measurement which will be used to represent some of the appropriate methods and activities for assessing student learning.

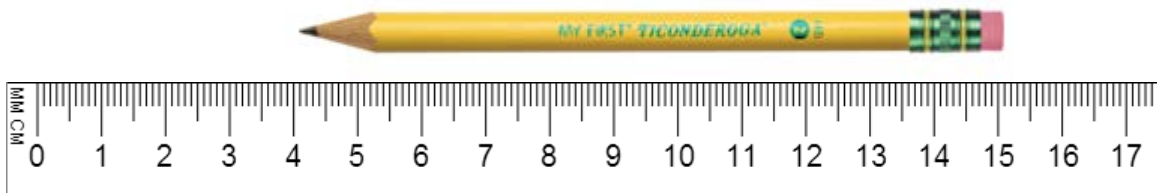
Encourage students to share their thinking, their strategies, and their solutions. Rich discussion fosters the development of alternative problem-solving strategies.

Examples:

1. What is the best unit to choose to measure the length of a season?

- ☐ Days
- ☐ Weeks
- ☐ Months

2. What is the length of the pencil below?



- ☐ 4 cm
- ☐ 11 cm
- ☐ 12 cm
- ☐ 15 cm

3. The width of your thumb is about

- ☐ 1 cm
- ☐ 10 cm
- ☐ 100 cm
- ☐ 1 m



4. The mass of a box of table salt is about

- ☐ 1 g
- ☐ 100 g
- ☐ 1 kg
- ☐ 100 kg



5. The mass of your mathematics book is about

- ☐ 10 g
- ☐ 100 g
- ☐ 200 g
- ☐ 1 000 g



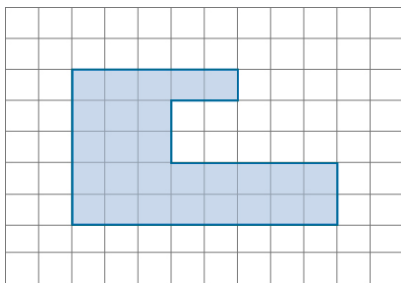
6. Which of the following statements is **true**:

- ☐ My chair is lighter than my marker.
- ☐ The mass of an orange is about 200 grams.
- ☐ The length of my arm is about 5 m.
- ☐ My pencil is longer than my mathematics book.

7. A garden is in the shape of a regular hexagon. One side of this hexagon is 2 m long. What is the perimeter of this garden?

- ☐ 12 m
- ☐ 10 m
- ☐ 8 m
- ☐ 6 m

8. What is the perimeter of the figure below? It is drawn on the 1 cm grid paper.



- ☐ 37 cm
- ☐ 30 cm
- ☐ 29 cm
- ☐ 28 cm

9. How many rectangles can you draw that have a perimeter of 16 cm each?

- ☐ 4
- ☐ 3
- ☐ 2
- ☐ 1

## Mathematics in Grade 4 Lesson Learned 7

### Geometry

Students need to continue developing their knowledge of 2-D shapes and 3-D objects by describing and sorting them according to their geometric attributes. Students need experiences to identify the faces, edges, and vertices of 3-D objects including spheres, cones, cylinders, pyramids, cubes and other prisms. Students need to be provided with opportunities to explore these attributes through sorting and constructing activities. Students need to extend their knowledge of both regular and irregular polygons. They need to focus on comparing the number of sides as the key attribute for classifying polygons. Students need more experiences with regular and irregular polygons, so that they begin to realize that a polygon, regardless of its dimensions, or position in space, remains the same shape.

#### A. What conclusions can be drawn from the Nova Scotia Assessment: Mathematics in Grade 4?

Students did very well when presented with questions related to 3-D objects, such as cylinders and spheres, found in their everyday life. They were able to identify the object being described. These were all application questions.

In the 2015–2016 Item Description Report, the following descriptions describe the questions with which students had difficulty

- determining how many vertices a pyramid has
- identifying an irregular pentagon in a composite shape
- sorting 3-D objects according to a given sorting rule
- choosing the statement that is false concerning the number of faces, vertices, and edges on a 3-D object
- determining the sorting rule for two sets of polygons

Many of these questions were analysis questions.

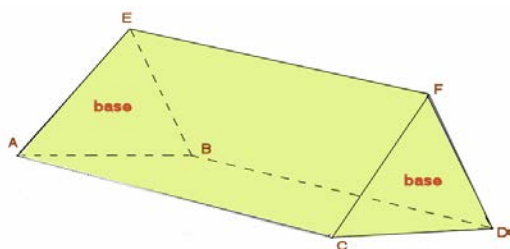
Students need to continue to develop their knowledge of geometry by describing and sorting 3-D objects according to their geometric attributes. Students require more experiences to identify the faces, edges, and vertices of 3-D objects including spheres, cones, cylinders, pyramids, and cubes and other prisms.

Students need to extend their knowledge to include both regular and irregular polygons. They need to focus on comparing the number of sides as the key attribute for classifying polygons. Students need be able to name the specific polygons including the triangle, quadrilateral, pentagon, hexagon, and octagon.

## B. Do students have any misconceptions or errors in their thinking?

A common misconception that many students make is they confuse faces, edges, or vertices on a geometric object. They have difficulty distinguishing what determines the faces, edges, or vertices of an object.

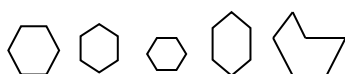
Another common error or misconception that students have is understanding that the base of a geometric object is whatever face it is sitting on. A pyramid or prism is named according to the shape of its base. A pyramid has one base and triangular faces. A prism has two matching bases that are polygons. The other faces are rectangles.



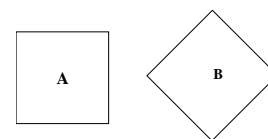
The two congruent triangles ABE and CDF are the two bases. The rectangles ABDC, ACFE and BDFE are the lateral faces.

When students are working with 3-D objects such as cylinders, cones, and spheres, they consider the rounded surfaces on these 3-D objects to be faces. This is an error or misconception. Another important concept for students to understand is that an edge occurs where two surfaces of a 3-D object meet. A vertex (vertices) is a point where three or more edges meet. (**Note:** On a cone and a pyramid the highest point above the base is called the apex. In a pyramid the apex is also a vertex, but for a cone, it is a mistake to refer to the apex as a vertex as there are no edges that meet.) As they become more familiar with identifying the attributes, students can determine the number of faces, edges, and vertices. Students will use informal language at this stage rather than precise mathematical language.

Although pattern blocks are frequently used for geometric inquiry, most of these shapes are regular. Students may develop the misconception that only certain familiar polygons meet the criteria for these shapes. For example, students may not initially recognize all of the shapes below as hexagons.



Some students incorrectly believe that the orientation of a geometric figure, changes the figure itself. Students recognize that shape A is square, but think that shape B is not a square.



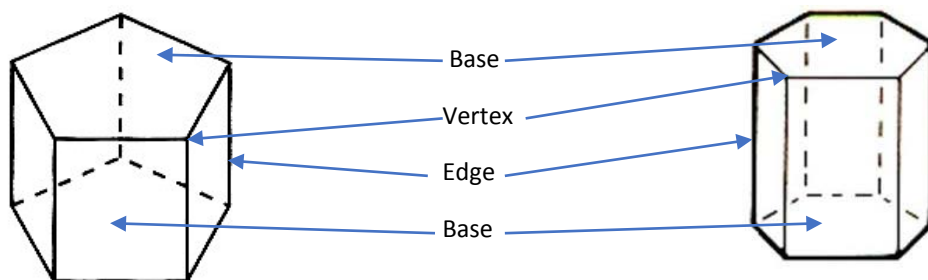
The student results of the 2016–2017 Nova Scotia Assessment Mathematics in Grade 4 shows the following data:

- 44% of the students were not able to correctly determine the number of vertices of a regular hexagonal pyramid.
- 54% of the students had difficulty recognizing a 3-D object described by its attribute (number of vertices, edges and faces).
- 57% of the students were not able to determine the sorting rule of polygons.
- 58% of the students were not able to recognize a polygon made by 2 geometric shapes (a triangle and a trapezoid).
- 74% of the students struggled when asked to sort a set of 3-D objects containing prisms and pyramids.



**C. What are the next steps in instruction for the class and for individual students?**

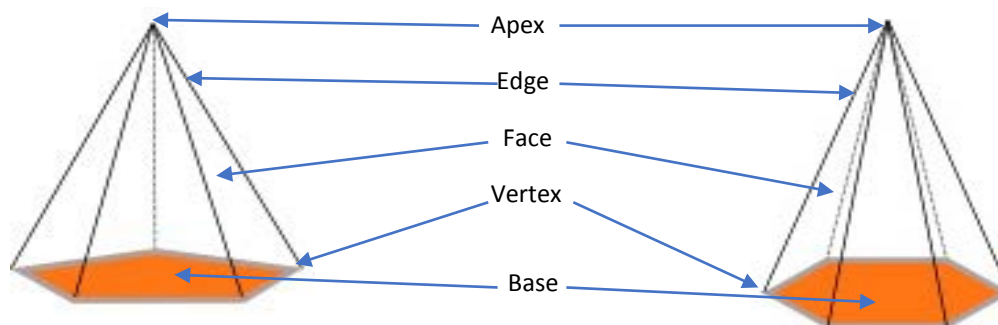
Students should be able to identify the faces, edges, and vertices as well as the shape of the faces of a given 3-D object.



This pentagonal prism has 7 faces (5 rectangular lateral faces and 2 pentagonal faces which are the 2 bases), 15 edges and 10 vertices.

This hexagonal prism has 8 faces (6 rectangular lateral faces and 2 hexagonal faces which are the 2 bases), 18 edges and 12 vertices.

Note: The lateral faces of a prism are **rectangles**. The two bases, that are also faces, are **polygons**. A prism is named by its bases.



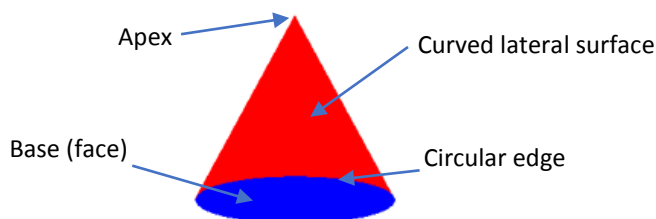
This pentagonal pyramid has 6 faces (5 lateral triangular and 1 pentagonal face, the base), 10 edges, 6 vertices (5 base vertices and 1 vertex or apex).

This hexagonal pyramid has 7 faces (6 lateral triangular and 1 hexagonal face, the base), 12 edges, 7 vertices (6 base vertices and 1 vertex or apex).

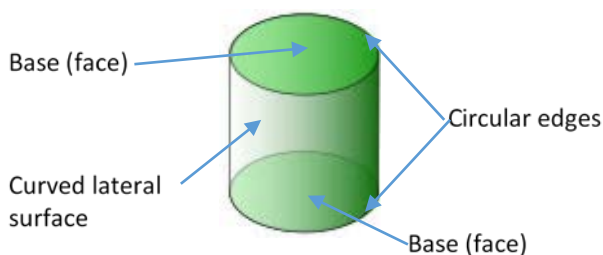
Note: The lateral faces of a pyramid are **triangles**. The base, that is also a face, is a **polygon**. A pyramid is named by its bases.

It is essential that students explore the attributes of a cone, a cylinder, and a sphere using manipulatives and concrete geometric materials. They must visualize these 3-D objects in order to understand their attributes.

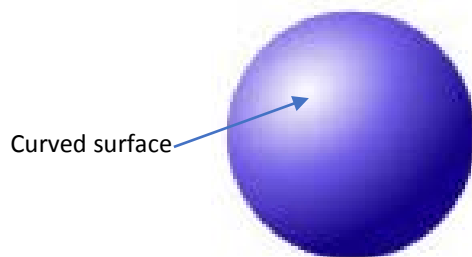
A cone has a circular flat face which is its base, a lateral curved surface starting from the base to the apex and a circular edge.



A cylinder has two circular flat faces which are its bases, a lateral curved surface joining the two bases and two circular edges.



A sphere has a curved surface. It does not have faces, edges or vertices.



Note: The curved surface of a cone, a cylinder or a sphere is not a face.

A suggested strategy to help students identify faces, edges, and vertices is to put a different colour of a small ball of modelling clay on each face, edge or vertex as they count. This should help students describe 3-D objects according to the shape of the faces and the number of edges and vertices.

A pyramid or prism is named according to the shape of its base. A strategy that may help with identifying the base of a geometric object is to remember that the base of a pyramid may not be a triangle. For a rectangular prism, any of the faces can be the base.

When working with 3-objects such as cylinders, cones, and spheres, students consider the rounded surfaces on these 3-D objects to be faces. The strategy suggested to help with this error or misconception is to help students with the conceptual understanding that a face is a flat surface on geometric objects.

Show students models and real-life objects of cylinders, cones, and spheres. Ask students what the difference is between these solids and the prisms and pyramids already studied. Show students the faces, edges, and vertices of each solid. Brainstorm, with the students, what each term means.

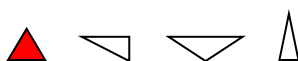
Students should be able to determine the number of faces, edges, and vertices of a given 3-D object.

- A cylinder is a 3-D object with 2 faces, 1 curved surface, 2 edges, and 0 vertices.
- A cone is a 3-D object with 1 face, 1 curved surface, 1 edge, and 1 apex.
- A sphere is a 3-D object with 1 curved surface, 0 faces, 0 edges, and 0 vertices.

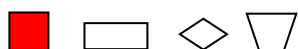
Students should compare and sort 3-D objects by observing the number of faces, edges, and vertices. A student may sort objects in various ways, such as those that have all square faces, those that have circular faces, those that have 8 vertices, or those that have straight edges. Students should play games with their peers in which they sort objects and ask their peers to guess the sorting rule according to the number of faces, edges, and vertices.

Students should focus on comparing the number of sides as the key attribute for classifying polygons. Students should be able to name the specific polygons—triangle, quadrilateral, pentagon, hexagon, and octagon. In the diagram below, the shaded polygons are regular polygons, and all others are irregular polygons.

3 straight sides: triangles

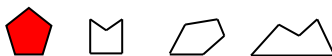


4 straight sides: quadrilaterals

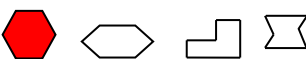


**Regular** polygons are shaded.

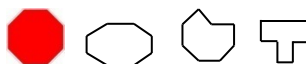
5 straight sides: pentagons



6 straight sides: hexagons



8 straight sides: octagons



Students should be given opportunities to explore both regular and irregular polygons while varying the positions and dimensions of the shapes. Provide students with a polygon to trace as they experiment with different positions by turning (rotating), flipping (reflecting), and sliding (translating). Through many experiences with identifying polygons in a variety of positions, students should begin to realize that a polygon, regardless of its position, remains the same shape.

Provide students with various sizes of a particular polygon. Have students count the number of sides and identify the polygon. Having a variety of these experiences with different polygons, students should begin to realize that a polygon, regardless of its dimensions, remains the same shape.

Students should find examples of polygons in the world around them, perhaps even collect as many types of a shape as they can find. Sort the shapes according to the number of sides. By sorting polygons according to the number of sides, students can learn the names for the polygons. The following are examples:



**D. What are the most appropriate methods and activities for assessing student learning?**

Below are some sample questions related to geometry which will be used to represent some of the appropriate methods and activities for assessing student learning.

Encourage students to share their thinking, their strategies, and their solutions. Rich discussion fosters the development of alternative problem-solving strategies.





Examples:

1. I am 3-D object. I have 5 faces, 8 edges and 5 vertices.



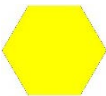

Which object am I?

- ☐ A rectangular prism
- ☐ A triangular pyramid
- ☐ A square prism
- ☐ A square pyramid

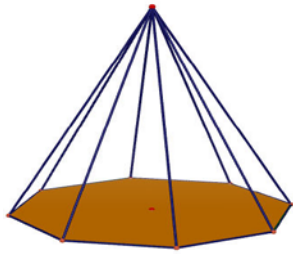
2. Which figure **is not** a polygon?

- ☐ 
- ☐ 
- ☐ 
- ☐ 

3. Which figure is a quadrilateral?

- ☐ 
- ☐ 
- ☐ 
- ☐ 

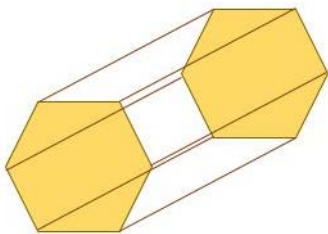
4. Look at the following pyramid:



Which statement is **true**?

- ☐ The pyramid has 9 faces, 9 edges and 9 vertices.
- ☐ The pyramid has a hexagonal base and 8 triangular faces.
- ☐ The pyramid has 8 triangular faces, 8 edges and 8 vertices.
- ☐ The pyramid has an octagonal base and 16 edges.

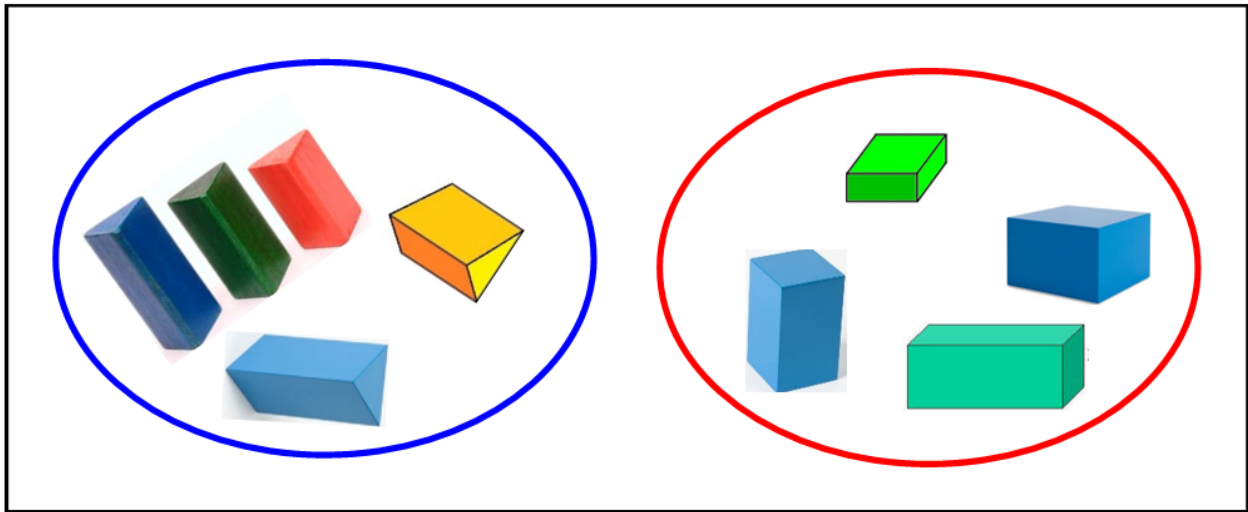
5. Look at the following prism:



Which statement is **true**?

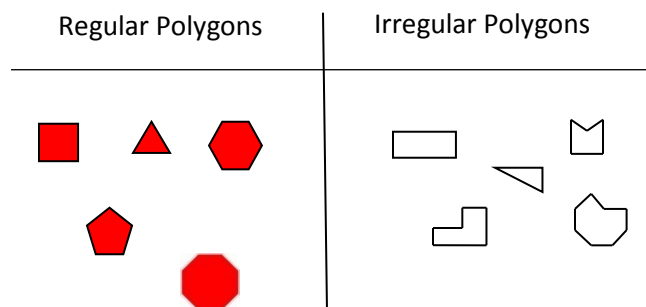
- ☐ The prism has 8 faces, 18 edges and 12 vertices.
- ☐ The prism has 6 faces, 18 edges and 12 vertices.
- ☐ The prism has bases and 8 rectangular faces.
- ☐ The prism has an octagonal base, 8 faces and 12 vertices.

6. Robert has sorted the following prisms using a Venn diagram:



Which sorting rule did he use?

- ☐ Prisms that have 6 faces and prisms that have more than 6 faces.
  - ☐ Prisms that have 6 edges and prisms that have 6 faces.
  - ☐ Triangular prisms and rectangular prisms.
  - ☐ Prisms which have 6 vertices and prisms which have 8 edges.
7. Lucie sorted these polygons.



- ☐ Polygons that have 4 sides and polygons that have 5 sides.
  - ☐ Polygons that are regular and polygons that are irregular.
  - ☐ Polygons that have 4 sides and polygons that have more than 4 sides.
  - ☐ Polygons that have 3 sides and polygons that have more than 5 sides.
8. Which object resembles a cone?



## Mathematics in Grade 4 Lesson Learned 8

### Statistics and Probability

Students were challenged using tally marks, lists, charts, line plots, and bar graphs to organize data relevant to their everyday life. Students need opportunities and experiences to interpret information collected, organized, and displayed in tally charts, charts, line plots and bar graphs. Students need to develop the skill of interpreting graphs, and answering questions and to draw conclusions from those tally charts, line plots and bar graphs. They need to be encouraged to ask or write questions that go beyond simplistic reading of a graph. Both literal and inferential comprehension questions need to be asked.

#### A. What conclusions can be drawn from the Nova Scotia Assessment: Mathematics in Grade 4?

Students did very well interpreting data from line plots. Line plots contain information that can be used to answer questions using a visual comparison, counting, and reading labels. It offers students a visual comparison of the different quantities of every piece of data. The cognitive level of these questions is application and analysis.

We noticed that students did very well when interpreting the data from a vertical bar graph when asked to answer a straight forward literal comprehension question about the data. They understood that they had to add all of the data together to find the correct answer. This was an application question.

Students had difficulty when asked to interpret a table showing the results of a survey using tally marks. They understood the concept of the tally table and what it represented, but could not interpret what they were being asked to answer for the data displayed. They did not realize that to answer the question, they had to compare two quantities and then subtract the smallest quantity from the largest in order to determine their answer. This was a knowledge question.

Students also had difficulty when asked to interpret a question displaying information in a bar graph. Again, they understood the concept of the bar graph and what it represented, but they did not realize that in order to answer the question, they had to perform an operation of addition with all the information given in each bar being displayed. This was an application question.

Students found it difficult to draw conclusions by comparing data represented in different types of displays. They were asked to draw a conclusion concerning the common attributes of line plots, horizontal bar graphs, pictographs, and vertical bar graphs with the same given set of data. They could not determine which data display did not represent the data correctly.

#### B. Do students have any misconceptions or errors in their thinking?

Although, students did well when working with line plots, they did make errors when reading or counting the Xs on a line plot.

The difficulty with bar graphs, whether horizontal or vertical, is that students interpret data from the wrong bar on the graph. Therefore, when asked to answer questions concerning the bar graph data, it is not correct.

A misconception or error that students have is concerning the common attributes of line plots, horizontal bar graphs, pictographs, and vertical bar graphs with the same given set of data. They should notice that the attributes that are common include the title, the labels, the horizontal axis, and the use of dots or crosses. They should also notice that the attributes can differ; for example, there could be different titles, different use of the horizontal axis, and different labels.

The student result of the 2016–2017 Nova Scotia Assessment Mathematics in Grade 4 shows the following data:

- 52% of the students were not able to interpret a bar graph.
- 54% of the students had difficulty to recognize the graph that represents a given set of data incorrectly.
- 66% of the students had difficulty to recognize the attributes of a bar graph.

### C. What are the next steps in instruction for the class and for individual students?

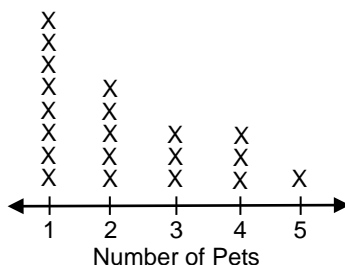
Students should be encouraged to collect, organize, and record their data using a tally system, line plots, charts, and lists to answer questions relevant to their everyday life. Using tally marks is a simple way for students to keep track of information as they collect it. Lists are a way for students to record the objects collected. A list can be made into a chart on which students would record their tally marks. Grouping the tally marks in fives makes it easier for students to total the numbers in each category by skip counting. When making a chart, students should always give it a title or heading to inform the reader about the meaning of the data. Students could then organize the data on line plots.

A line plot provides a bridge from tally charts to bar graphs. At first, students should create their line plots using grid paper, with one dot or cross per grid paper square. The dots or crosses are placed one above the other for each tally mark for each item in the list or chart. Students should then count and write the total number of Xs under each column shown on the line plot. Students should notice that the attributes that are common include the title, the labels, the horizontal axis, and the use of dots or crosses. They should also notice that the common attributes can differ; for example, there could be different titles, different use of the horizontal axis, and different labels. They might also notice that when a line plot does not have a title as in the following picture, it is hard to make sense of the graph.

**Tally system**

| Number of Pets | Number of Students |
|----------------|--------------------|
| 1              | TTTT III           |
| 2              | TTTT               |
| 3              | III                |
| 4              | III                |
| 5              | I                  |

**Line plot**



**Chart/List**

| Number of Pets | Number of Students |
|----------------|--------------------|
| 1              | 8                  |
| 2              | 5                  |
| 3              | 3                  |
| 4              | 3                  |
| 5              | 1                  |

After a display of the data is constructed, discussing the information that can be obtained from the display is a valuable exercise. Students should work together to formulate questions that can be answered by other students using the data in the line plot, chart, or list. For example, from a line plot that displays the number of letters in your last name, students might formulate questions such as, What is the most common number of letters in a name? How many letters does the longest name in the class have? Shortest?



A good graph should communicate some overall impressions of the data to a reader. Students should be able to answer questions using the display of the collected data. It is also important that each graph accurately represents the data and includes clear labelling and a title.

Present students with vertical and horizontal bar graphs that represent two different sets of data. Discuss what common attributes the two bar graphs have, such as title, axes, and labels for the axes, numerical scale, and bars. Discuss how the two bar graphs are different; for example, the titles of the graphs, labels for the axes, lengths and widths and spacing of the bars, and how some graphs have horizontal bars and others have vertical bars.

Once data has been collected, it should be organized and displayed so that questions can be asked and answered. Students have made line plots that have common attributes and the appearance of a bar graph. Students can discuss how they can change their line plots into bar graphs. As they create their bar graphs, have them check to see if all the attributes of the bar graph are visible.

Although students may be able to create bar graphs, they have trouble matching the length of the bars to the numbers on the scale, whether it is a vertical or horizontal bar graph. To help students with this error, have them use a ruler to line up the tops of the bars with the scale. Students should also be asked to match the information they are looking for with one of the categories on the axis with the correct title/category of the bar.

Students should also be presented with vertical and horizontal bar graphs that represent two different sets of data. Discuss what common attributes the two bar graphs have, such as title, axes, and labels for the axes, numerical scale, and bars. Discuss how the two bar graphs are different; for example, the titles of the graphs, labels for the axes, lengths and widths and spacing of the bars, and how some graphs have horizontal bars and others have vertical bars.

Students also experienced some difficulty drawing conclusions from graphs. To develop the skill of interpreting graphs, students should be given bar graphs and be asked to draw conclusions. They should be encouraged to ask or write questions that go beyond simplistic reading of a graph. Both literal and inferential comprehension questions should be asked, such as, What can you tell about \_\_\_\_\_ by looking at this graph? How many more/less than ...? Based on the information presented in the graph, what other conclusions can you make? Why do you think \_\_\_\_\_? For example, when trying to solve the problem about what foods should be offered in the cafeteria, students would examine a bar graph that has the title, What Foods Should Be Available on the Cafeteria Menu? and be able to tell what food selections were considered the favourites by noticing which bars are the highest or longest. They may also draw conclusions that more students want healthy food for lunch than not healthy food.

Students should understand that to solve some problems, collecting and organizing graphs can help people to reach conclusions. Data is usually collected to answer questions, to discover something of interest, or most importantly, to solve a problem. Some examples of problems students might be interested in include, What should students be allowed to do during the lunch break? What foods should be available on the cafeteria menu? What foods should be removed from the cafeteria menu? What activities would you like to do in the gym? To answer questions like these, or to solve these kinds of problems, students could collect and display data, then interpret it.

**D. What are the most appropriate methods and activities for assessing student learning?**

Below are some sample questions related to statistics and probability which will be used to represent some of the appropriate methods and activities for assessing student learning.

Encourage students to share their thinking, their strategies, and their solutions. Rich discussion fosters the development of alternative problem-solving strategies.





Examples:

1. Emma asked her classmates a question to collect data. She recorded their answers in the following list:

| Favourite Films of the Students |   |
|---------------------------------|---|
| Drama                           | 3 |
| Science Fiction                 | 4 |
| Comedy                          | 6 |
| Action                          | 2 |

Which question did Emma ask her classmates?

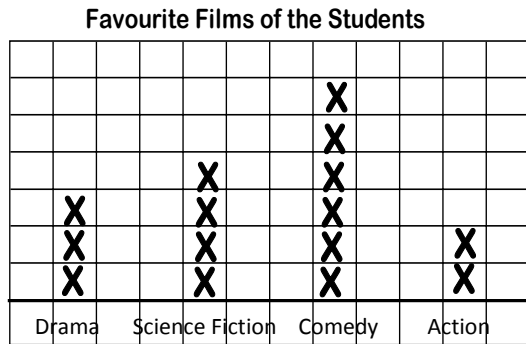
- ☐ Do you prefer films about the police?
  - ☐ Do you prefer comedy more than action films?
  - ☐ What kind of films do you prefer?
  - ☐ Do you prefer drama more than action films?
2. Emma constructed the following pictograph to present the collected data about her classmates. She made some errors.

| Drama             |  |
|-------------------|---|
| Science Fiction   |  |
| Comedy            |  |
| Action            |  |
| Represents 1 film |   |

What error did Emma make?

- ☐ She forgot the title.
- ☐ The number of comedy films is not equal to the number recorded in the list above.
- ☐ She forgot the legend.
- ☐ She forgot the title and the legend.

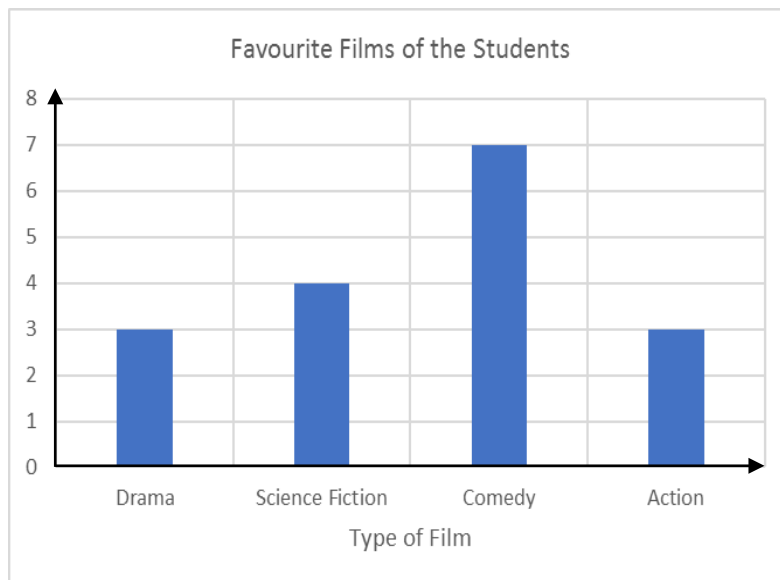
- 3.** Emma presented the collected data above in the following line plot:



How many more comedy films than action films did the students choose?

- 2  
○ 4  
○ 8  
○ 9

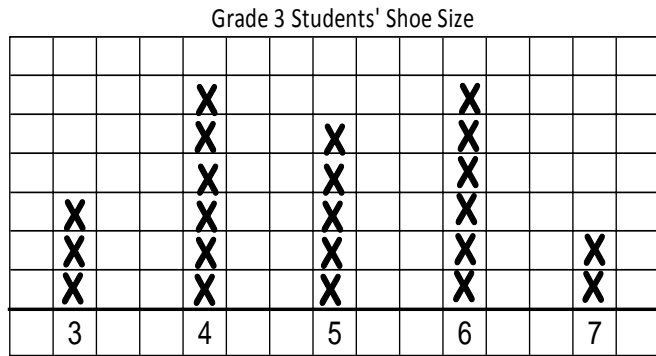
4. Tanya used the data collected by Emma to construct the following bar graph:



Examine the bar graph. What errors did Tanya make?

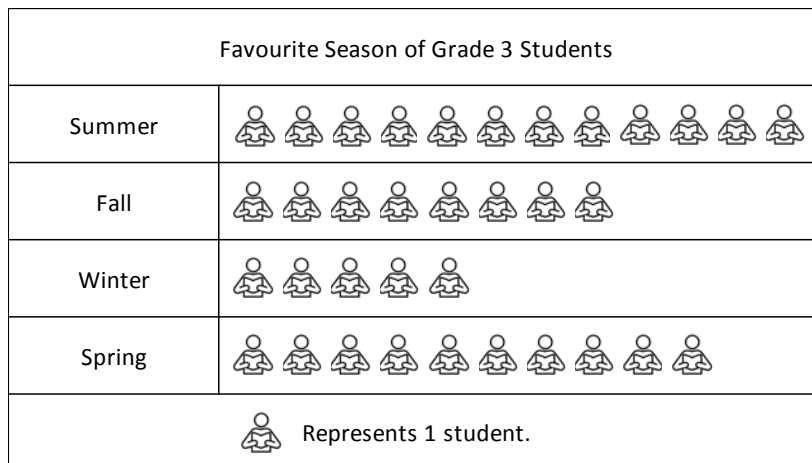
- ☐ The axes labels are missing.
- ☐ The vertical axis label and the title are missing.
- ☐ The bars for comedy and action are not correct.
- ☐ The vertical axis label and the bar for comedy are missing.

5. The line plot below shows the shoe size of Grade 3 students.



What conclusion can you draw from this line plot?

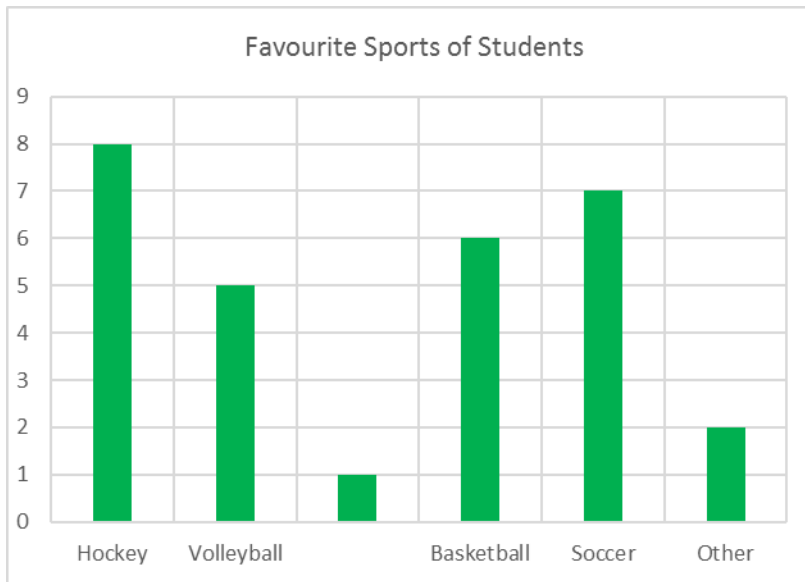
- ☐ There are more students with size 5 shoes, then size 4 shoes.
  - ☐ There are more students with size 7 shoes, then size 3 shoes.
  - ☐ There are fewer students with size 6 shoes, then size 7 shoes.
  - ☐ There are just as many students with size 4 shoes, as students with size 6 shoes.
6. Tony asked the Grade 3 students about their favourite season. The pictograph below shows the results of Tony's survey.



Which statement is **true**?

- ☐ Spring is the most popular season.
- ☐ Fall is the least popular season.
- ☐ Fewer students prefer fall to winter.
- ☐ Summer is the most popular season.

7. Christine asked her 29 classmates to name their favourite sport. The bar graph below shows the results of her survey.



What errors did Christine make?

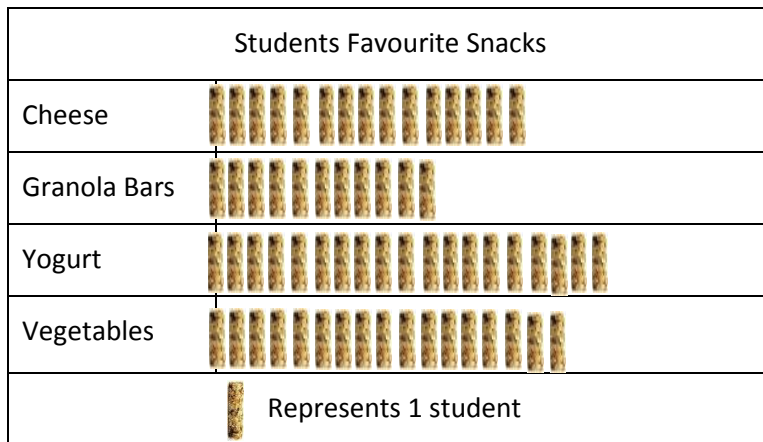
- ☐ The labels of the axes and the title is missing.
  - ☐ The labels of the axes and the name of a sport are missing.
  - ☐ The bars are not the same width.
  - ☐ The total number of students in the graph is not equal to 29.
8. The table below shows the results of a survey of students favourite snacks.

| Favourite Snacks of Students |        |
|------------------------------|--------|
| Snacks                       | Number |
| Cheese                       |        |
| Granola Bars                 |        |
| Yogurt                       |        |
| Vegetables                   |        |

How many more students prefer vegetables than cheese?

- ☐ 17
- ☐ 15
- ☐ 11
- ☐ 2

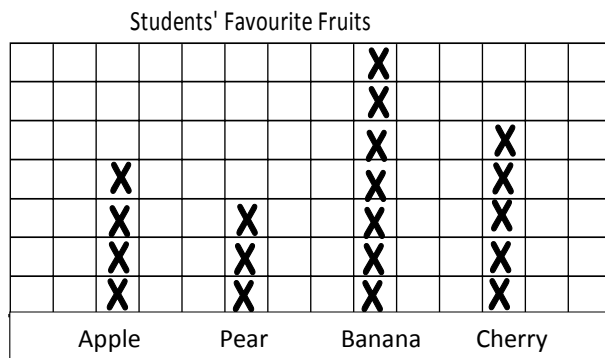
9. Sherene uses the data above to construct the pictograph below to show the results of students favourite snacks.



Which statement is true?

- ☐ There are 30 students who prefer granola bars and yogurt.
- ☐ There are 23 students who prefer cheese and yogurt.
- ☐ There are 27 students who prefer granola bars and vegetables.
- ☐ There are 35 students who prefer yogurt and vegetables.

10. Kyle surveyed the Grade 2 students about their favourite fruits. The line plot below shows the results of this survey.



Which statement is **true**?

- ☐ The students prefer apples to bananas.
- ☐ The students prefer pears to cherries.
- ☐ The apple is the most popular fruit.
- ☐ The pear is the least popular fruit.