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Measurement Learning Activities – Grade 4

The First Decade of My Life

Strand: Measurement, Grade 4

Big Idea: Attributes, Units, and Measurement Sense

Overview

In this learning activity, students create a time line of significant events that occurred during the first decade of their life. Significant events may include important world events, important innovations, and personal or family milestones. Time lines such as these provide a rich context for posing and responding to more complex mathematical problems, and for working with a variety of Fermi questions. This learning activity can be effectively linked to Heritage and Citizenship: Grade 4 – Medieval Times.

The learning task builds upon students' prior learning of relationships between years and decades and extends their understanding to the relationships between years and decades, and between decades and centuries. Before starting this learning activity, students will need opportunities to read and interpret sample time lines. They will also need to have an understanding of how to solve problems involving relationships between minutes and hours, hours and days, days and weeks, and weeks and years, using a variety of tools.

Curriculum Expectations

Overall Expectations

- **Attributes, Units, and Measurement Sense:** estimate, measure, and record length, perimeter, area, mass, capacity, volume, and elapsed time, using a variety of strategies;
- **Measurement Relationships:** determine the relationships among units and measurable attributes, including the area and perimeter of rectangles.

Specific Expectations

- **Attributes, Units, and Measurement Sense:** estimate and determine elapsed time, with and without using a time line, given the durations of events expressed in five-minute intervals, hours, days, weeks, months, or years;
- **Measurement Relationships:** solve problems involving the relationship between years and decades, and between decades and centuries.

About the Learning Activity

Time: 4 hours

Materials

- **M.BLM4a.1: Home Connections: Personal Time Line**
- paper (bristol board, chart paper, or butcher paper); markers; glue
- informational texts and/or Internet access
- clock or stopwatch; calculators; calendar
- optional: family pictures; toothbrush and toothpaste; math journals

Mathematics Language

- units of measurement for time (e.g., century, days, decade, hours, minutes, years, months)
- elapsed; duration; time line; frequency; innovations; time anchors

Instructional Grouping: individual and partners

About the Math

Fermi Questions

Fermi questions emphasize estimation, numerical reasoning, communicating in mathematics, and questioning skills. Students often believe that "math problems" have one exact answer and that the answer is derived in a unique manner. Fermi questions encourage multiple approaches, emphasize process rather than "the answer", and promote non-traditional problem solving strategies. (Talamo, 1996)

Getting Started

Instructions to students

Describe the following scenario to the class:

"A time line is an effective organizer for recording important events and innovations. Over the next several days you will be creating your own personal time line, detailing the first decade of your life. Your time line will include significant personal and family events, world events, and important innovations. In order to complete this time line you will be required to gather information from your family as well as from secondary resources, such as informational texts or the Internet. Your time line will be shared with your classmates and used to investigate interesting facts from the first decade of your life."

Teacher Note: Having students create and share personal time lines will provide an authentic opportunity to celebrate diversity in your classroom.

Teacher Note: When discussing elapsed time on the sample time lines, direct conversation to the appropriateness of the unit used to describe the duration, frequency, and time between events. Select a variety of events or innovations in order to ensure that various units are used to describe elapsed time. Model the language of approximation when describing elapsed time.

Working on It

Stage One: Creating a Personal Time Line

Before beginning this task, give students time to reflect and connect by brainstorming what they know about time lines. As a group, review sample time lines to examine and note organizational structures and features.

Discuss the supplies that are available and have the students do research on resources. Provide direction on the number of events and innovations that should be included per year on each time line. Encourage students to strive for a balance between personal events, world events, and important innovations.

> **Teacher Note:** Teachers may decide to share a historical time line linked to Heritage and Citizenship: Grade 4 – Medieval Times. A historical time line will provide opportunities to discuss elapsed time and to investigate the relationships between years and decades, and between decades and centuries.

To facilitate comparison through shared discussion, you may decide to select specific events that must be represented on all time lines.

Examples of questions related to personal events might include:

- When did you learn to talk?
- When did you learn to walk?
- When did you start school?
- When did you get your first tooth?

A key feature of each time line will be notations indicating the amount of elapsed time within and between events. Specify a reasonable number of notations per time line. It is important for students to recognize that when indicating elapsed time, certain notations will require a greater degree of precision than others.

> **Teacher Note:** When discussing key events on a sample time line, it is best to focus on elapsed time, given the time and duration of specific events. In discussions and shared investigations, elapsed time can be expressed in intervals of five minutes or in hours, days, weeks, months, or years.

> **Teacher Note:** This component of the learning task offers an excellent opportunity for a home connection. Interviewing a parent about important personal milestones, family events, and significant world events will enrich this task for students. With parental permission, family photographs could be used to visually represent key events on the time line (see Home Connection 1 on **M.BLM4a.1**).

As students work on their personal time lines, circulate and conduct individual conferences. During this phase, you will be able to assess students' understanding of elapsed time by discussing their notations of the duration of specific events, milestones, or innovations. Focus on whether students have selected an appropriate unit of measurement, and also on their recognition of the degree of precision required. Students can then share their completed time lines in a "Gallery Walk" (where students display their work for others to view) or in "Sharing Circles" (where students share their work in small or large group settings). At this point in the activity you may decide to have students complete a math journal entry, focusing on describing elapsed time and on noting an appropriate degree of precision.

Teacher Note: Using the language of approximation, relate events that occur naturally throughout the school day to various units of time. Experiences that allow students to estimate, measure, and record time intervals to the nearest minute will provide foundational knowledge for this learning task. Everyday references and experiences will help students to develop benchmarks for time, thus providing an anchor for reasonable estimation.

Teacher Note: See the music video of the song *Help me Fermi* at http://publish.edu.uwo.ca/george.gadanidis/fermi. The Fermi questions asked in this song may motivate students to ask and explore their own questions.

Scaffolding suggestion: You might ask students to sketch a time line with notches to indicate units of elapsed time. A student who learned to walk at 18 months could be asked to locate this point on his or her time line. By counting forward six months and eight years, the student would be able to determine the amount of elapsed time between when he or she learned to walk and the present.

Stage Two: Fermi Questions

Students focus on the elapsed time related to a specific event in order to solve rich problems involving the relationship between years and decades, and between decades and centuries.

Estimating tooth-brushing time

Say to the students:

"You have been sharing personal events, world events, and important innovations using your personal time line of the first decade of your life.

Every day, we spend considerable time completing daily routines. Tooth-brushing is one of those routines. In the next part of the time line activity you will be adding time anchors related to tooth-brushing. You will be working with a partner to consider the following questions:

- Approximately how much time might a person spend brushing his or her teeth in one year?
- Approximately how much time might that person spend brushing his or her teeth in one decade?
- Approximately how much time could that person spend brushing his or her teeth in half a century?

Teacher Note: Discuss student estimations, connecting to benchmark references noted in daily classroom routines. You may decide to chart these estimates on a class tally.

Let's begin by estimating, to the nearest minute, how long it takes to brush your teeth:

- Approximately how much time do you think it takes you to brush your teeth?
- How many times per day do you brush your teeth?
- Approximately how much time do you think you spend on tooth-brushing each day?"

There are several ways to proceed with the task at this point. For instance:

- You could consider a home-school connection. Have students ask a parent to measure the time they (the students) take to brush their teeth at home. The data will be shared at school the next day.

- If a classroom sink is available, you could brush your teeth (or a student volunteer could do so) while the rest of the class uses an appropriate tool to measure the duration of the event to the nearest minute.
- You could discuss the fact that toothbrush timers usually run for two minutes. Generally speaking, two minutes is the recommended minimum time for a tooth-brushing session.

Solving the problem

If your students have collected data at home, provide the following instructions:
The amount of time per tooth-brushing session will vary, as will the number of times per day that you brush your teeth; therefore, you and your partner will have to use the data you have collected to decide on a reasonable estimate of the number of times you brush your teeth each day and a reasonable estimate of how long each tooth-brushing session lasts

Alternatively, the class can decide on a specific tooth-brushing time and frequency that all students will use while working on this task. This specific length of time and frequency could be based on the tooth-brushing demonstration or on the two-minute recommended guidelines. Now is an ideal time to clarify students' understanding of the task. Ask them:

- What is this problem asking you to determine?
- What strategies could you use to begin solving this problem?
- What materials and tools could you use to solve this problem?
- How might you organize your thinking effectively so that you can share your solution with your classmates?

Teacher Note: It might be useful to create an anchor chart with your students to display the relationships between minutes and hours, hours and days, days and weeks, weeks and years, years and decades, and decades and centuries.

Working in pairs, students record their thinking on chart paper. As they investigate the relationships between years and decades, and between decades and centuries, they will be engaging in computations with increasingly large values. Calculators will allow them to focus on mathematical reasoning and communication during this task. The task will culminate in a whole-group sharing session, after which students will indicate on their personal time lines time anchors drawn from the calculations.

As the students work on this task, observe how effectively they use the relationships between minutes and hours, hours and days, days and weeks, weeks and years, years and decades, and decades and centuries.

Note to Teacher: Rich assessment data can be gathered while observing the degree to which students work flexibly with units of time. The solution to the problem could be presented in minutes but a student who works flexibly will be able to recognize and use larger units of time.

Reflecting and Connecting

Skilfully led discussions provide opportunities for students to ask questions of one another, to share ideas, and to justify their reasoning. As students reflect and connect through shared discussion, they deepen their understanding of attributes, units, measurement sense, and measurement relationships. Draw students' attention to the different formats used to create their personal time lines. Discuss the tooth-brushing problem, focusing on process. In sharing sessions, such as a "Gallery Walk" or "Sharing Circles", students can compare approaches, self-assess, and set goals as they continue to work on the problem.

Draw a horizontal bar on the board, placing a zero at the start of the bar and a ten at its end. Explain to students that this bar represents their first decade. Ask them to consider what portion of this decade was spent on tooth-brushing and whether it is possible to represent this portion visually on the bar, by shading the portion of the bar that represents the total tooth-brushing time. Students should realize that it would be difficult to do this because tooth-brushing is a very short activity. Ask them to brainstorm daily activities that take longer than tooth-brushing. For example, sleeping, walking, or talking. Ask them to estimate the portion of the decade spent on each of these activities, by indicating the portion of the decade bar that might be shaded. For example, if someone sleeps an average of 8 hours per night, then one-third of the decade bar would be shaded.

Tiered Instruction

Supports and extensions can be beneficial for all students. For any given activity, there will always be some students who require more or less support, or for whom extensions will increase interest and deepen understanding.

Supports for student learning

- This learning activity provides excellent opportunities for differentiated instruction; it requires students to make choices and offers multiple entry points. The open-ended nature of the Fermi question allows students to use varying levels of sophistication to interpret information and select units.
- Ongoing assessment will allow you to provide feedback and to scaffold instruction. For example, you might simplify the time line task by having students use more approximate, larger units of time to calculate elapsed time.
- Some students may require individual assistance to organize their information. Anchor charts, particularly those created by the class, as well as sample time lines, will be critical reference tools for some students.

Extensions

Wasting Water. According to Environment Canada, the average Canadian uses 335 L of water per day. Daily water use in Canada is higher per person than in most other countries. Conservationists are urging Canadians to protect our fresh water supplies and not waste them. Every time someone leaves the tap running while brushing his or her teeth, 10 L to 20 L of water are wasted. Challenge students to determine the answer to the following Fermi question: If you were to leave your tap running every time you brushed your teeth, how much water would you use in one year, one decade, and one century? This extension connects to Life Systems: Habitats and Communities.

Happiness Scale. A second possible extension involves the measurement of happiness in relation to events on the time lines. As students reflect on significant events, some events may evoke a stronger emotional response than others. Ask students to assign happiness values to a selection of events, using a scale of 0-10. The results may then be represented using a broken-line graph, where the horizontal axis is the timeline and the vertical axis is the Happiness Scale.

Accounting for Our Time. Have each student create a personal time line to track, record, and account for a 24-hour period of their lives. The data will be used to determine elapsed time and to analyse how time is being spent. Students will represent elapsed time using a variety of units, which can then be converted to fractions. For example, “I sleep for about eight hours each day; therefore, I spend approximately one third of my day sleeping.”

Exploring Additional Fermi Questions. Many other Fermi questions would provide rich learning connections for this learning activity. For example: How much time will a person spend sleeping in one year? In one decade? In a lifetime?

Home Connections

See **M.BLM4a.1**.

Assessment

Ongoing assessment opportunities are embedded throughout this activity as suggested prompts and questions. Some additional assessment questions are:

- How did you decide what degree of precision was required when calculating elapsed time?
- How did you use benchmarks to estimate time?
- How did you use relationships between units to solve problems?

Rubric

Assessment category	Level 1	Level 2	Level 3	Level 4
Knowledge and understanding				
– estimates and determines elapsed time	☐ limited	☐ some	☐ considerable	☐ thorough
– uses and understands the relationships among minutes, hours, days, weeks, months, years, decades, and centuries	☐ limited	☐ some	☐ considerable	☐ thorough
– identifies linear patterns and non-linear patterns	☐ limited	☐ some	☐ considerable	☐ thorough
– constructs tables, graphs, and diagrams	☐ limited	☐ some	☐ considerable	☐ thorough
Thinking				
– creates plan of action for exploring Fermi questions	☐ limited	☐ some	☐ considerable	☐ high degree
– identifies and uses patterns in problem solving	☐ limited	☐ some	☐ considerable	☐ high degree
– makes predictions for pattern growth in time lines and Fermi questions	☐ limited	☐ some	☐ considerable	☐ high degree
– explores alternative solutions	☐ limited	☐ some	☐ considerable	☐ high degree
Communication				
– explains mathematical thinking	☐ limited	☐ some	☐ considerable	☐ high degree
– communicates using a variety of modes (short answers, lengthy explanations, verbal and written reports)	☐ limited	☐ some	☐ considerable	☐ high degree
– uses appropriate vocabulary and terminology	☐ limited	☐ some	☐ considerable	☐ high degree
Application				
– applies measurement skills in familiar contexts	☐ limited	☐ some	☐ considerable	☐ high degree
– transfers knowledge and skills to new contexts	☐ limited	☐ some	☐ considerable	☐ high degree
– makes connections among concepts	☐ limited	☐ some	☐ considerable	☐ high degree

M.BLM4a.1 Home Connections: Personal Time Line

Home Connection 1:

Dear Parent/Guardian,

As part of our measurement unit, your child will be creating a personal time line at school. Students will be using these time lines to calculate elapsed time. They will be determining the duration of events as well as the amount of time between events. To assist your child in this activity, and to ensure that the time lines are personally relevant, please answer the following questions related to your child's first decade:

- When did I learn to walk?
- When did I learn to talk?
- When did I get my first tooth?
- What were three important family events, and when did they take place?
- What were three significant world events that occurred during my first decade, and when did they take place?

You and your child may wish to select family photographs or artifacts to provide visual representations for the time line.

You may decide to extend the time line by going back in time to the birth date of other family members.

Sincerely,

Home Connection 2:

Dear Parent/Guardian:

Thank you for assisting your child by providing details regarding the timing of important milestones and events in your child's first decade. Please take time to celebrate the completion of this task by having your child explain the mathematics involved.

Sincerely,

Designing a Kindergarten Play Enclosure

Strand: Measurement, Grade 4

Big Idea: Measurement Relationships

Overview

In this learning activity, students investigate the relationship between perimeter and area in the context of designing a Kindergarten play enclosure. Students use a variety of tools to measure and record, to the nearest metre, the perimeter of the existing play enclosure or the perimeter of a space delineated by the teacher. Working with this defined perimeter, students explore the areas of possible rectangular enclosures, modelling their findings using a variety of manipulatives. Students are asked to determine the most effective use of space, while evaluating the way in which the space is to be used and taking into account structural features of the school.

Students will need to bring an understanding of the attributes of perimeter and area to this task, as well as experiences in using concrete materials to measure lengths and cover classroom surfaces. In addition, they must be able to recognize a number of familiar benchmarks for a metre.

Curriculum Expectations

Measurement Relationships

Overall Expectations

- determine the relationships among units and measurable attributes, including the area and perimeter of rectangles;
- determine, through investigation, the relationship between the side lengths of a rectangle and its perimeter and area.

Specific Expectations

- pose and solve meaningful problems that require the ability to distinguish perimeter and area (e.g., “I need to know about area when I cover a bulletin board with construction paper. I need to know about perimeter when I make the border.");

- compare, using a variety of tools (e.g., geoboard, patterns blocks, dot paper), two-dimensional shapes that have the same perimeter or the same area.

Attributes, Units, and Measurement Sense

Overall Expectation

- estimate, measure, and record length, perimeter, area, mass, capacity, volume, and elapsed time, using a variety of strategies.

Specific Expectation

- estimate, measure, and record length, height, and distance, using standard units (i.e., millimetre, centimetre, metre, kilometre).

About the Learning Activity

Time: 2 hours

Materials

- **M.BLM4b.1: Recording Chart**
- overhead transparencies, overhead projector, chart paper, markers
- manipulatives for modelling area (dot paper, grid paper, geoboards, geobands, coloured tiles, connecting cubes)
- measurement tools (string cut into metre lengths, metre sticks, trundle wheel)

Mathematics Language

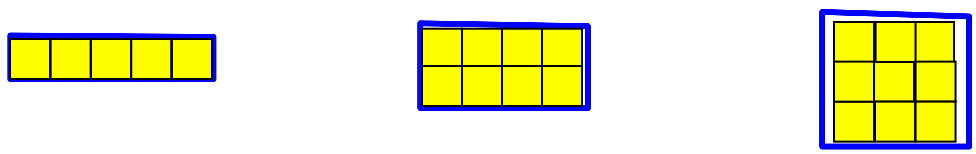
Area, length, metre, square metres (m^2), patterns, perimeter, rectangle, relationships

Instructional Grouping: pairs and/or small groups

About the Math

Area-perimeter relationships

A key learning of this activity is that two rectangles with the same perimeter will not always have the same area. When comparing rectangles with the same perimeter, students discover that the rectangle with the largest area will be a square. For example, for a perimeter of 12 units, we can use square tiles to show a variety of configurations. Notice that the area changes, and that the largest area is formed using a square.



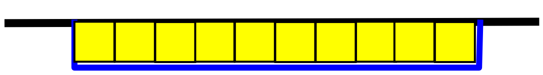
Perimeter = 12 units
Area = 5 square units

Perimeter = 12 units
Area = 8 square units

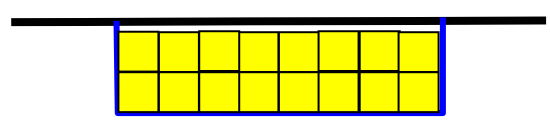
Perimeter = 12 units
Area = 9 square units

Fencing a rectangular area against an existing wall

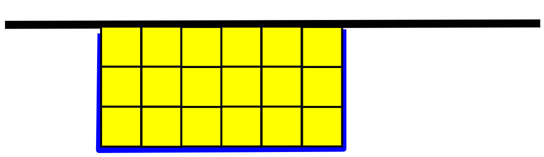
When we fence areas against an existing structure (such as a school), we only need to fence three sides. In this case, notice that the greatest area is given by a rectangle whose width is twice its length (not a square). In an extension of this learning task, students consider how the perimeter and area could be affected, given a fixed amount of fencing and the option to use any length of the school wall.



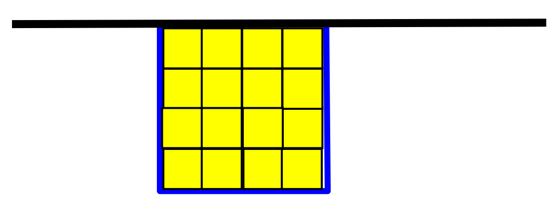
Fence = 12 m
Area = 10 m^2



Fence = 12 m
Area = 16 m^2



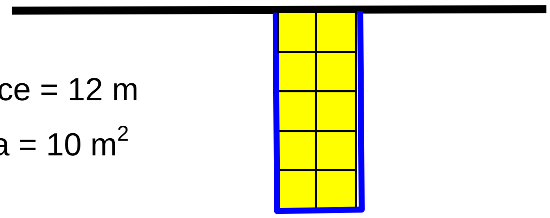
Fence = 12 m
Area = 18 m^2



Fence = 12 m
Area = 16 m^2

Fence = 12 m

Area = 10 m^2



Getting Started: Measuring and Recording

Introducing the problem

For schools with a Kindergarten play enclosure:

Instructions to students

Describe the following scenario to the class:

"From time to time the pavement in school play areas needs to be resurfaced. Because this involves removing the fence around the Kindergarten play enclosure, we have the opportunity to decide if this defined space has been designed in the most effective manner. The perimeter of the space cannot be changed, and the shape of the space must be rectangular. However, the dimensions of the rectangular space can change. In order to make an informed decision, we will first need to estimate and measure the dimensions and the perimeter of the existing play space."

For schools without a Kindergarten play enclosure:

Instructions to students

Describe the following scenario to the class:

"Some parents and teachers have expressed a concern regarding the safety of Kindergarten students on the playground. Some adults feel that it would be safer if there were an enclosed space in which Kindergarten students could play. I have marked off a rectangular space outside that I feel would be an appropriate size to allow the Kindergarten students to enjoy their favourite activities without interfering with the play space of other students. You will have the opportunity to decide if the space I have created has been effectively planned. In order to make this decision, you will first need to estimate and measure the dimensions of the space I have created."

Teacher Note: Before you introduce this activity, mark a rectangular space using pylons.

Measuring the Kindergarten play area

Both Scenarios:

"Consider the following questions:

- How will we estimate and measure the dimensions of this play enclosure?
- Which of our measuring tools will be most efficient in measuring the dimensions?
- How will the dimensions help us to determine the perimeter of this play space?

When you visit the Kindergarten play enclosure you will be creating a visual representation of this space. You will need to measure and record the lengths of each side of the enclosure and calculate the perimeter. In your visual representation, include structural features (e.g., doors, windows) that could have an impact on possible play area designs. Remember that hedges, the proximity of parking lots, and other factors might affect your final design choice. The space has to be organized in a way that will allow Kindergarten students to engage in their favourite activities."

Teacher Note: You may wish to have students observe the Kindergarten students at play or reflect on their own experiences as Kindergarten students. This information could be recorded in a visual format such as a Mind Map or other brainstorming web.

Have the students visit the Kindergarten play enclosure and use benchmarks to estimate the perimeter of the space, working in pairs to note and record structural features. Select class representatives to measure the length of the sides of the enclosure to the nearest metre, using a variety of measurement tools.

Teacher Note: Where students are measuring a Kindergarten enclosure that is not rectangular, it will be important to consider how best to proceed with the problem. You might choose to have students work with only a rectangular portion of the yard or to subdivide the current space into manageable sections.

Modeling the problem

After students have returned to the classroom, have them compare the measurements recorded by the class representatives. Comparing these measurements will allow the class to generate a set of data that will be used to measure the effectiveness of benchmark estimates and to complete the rest of the task. Students must be able to recognize the standard units that apply to this task. At this point, they might use a math journal entry to reflect on the accuracy of their benchmark estimate as it compared with actual measurements of the space.

Ask students to use a range of appropriate manipulatives, representing the standard unit, to:

- model the perimeter of the existing play space and determine the area;
- model alternative rectangular play areas with the same perimeter;
- record, for each design, the lengths of each side and the area;
- look for patterns in their data;
- select a design to best meet the needs of the Kindergarten students, while taking into account structural features of the building and surrounding space, and justify their reasoning.

Teacher Note: You may wish to generate specific criteria with your students, such as:

- creating a space with the largest area;
- addressing how the students are going to use the space; for example, a space that is one metre wide and very long will not allow the Kindergarten students to safely ride their tricycles.

The goal is for the students to use their knowledge and understanding of measurement and shape to determine the most effective use of space while evaluating both the way the space is to be used and the impact of the structural features of the school.

Working on It

Designing the new Kindergarten play area

Asking the following key questions will allow you to check for understanding:

- What data have we already gathered and recorded?
- As we explore this challenge, what data must remain constant?
- How would you describe the challenge in your own words?

Explain to students that they will be required to work with partners or in small groups and represent their work on a sheet of chart paper that will be displayed on the walls of the classroom. Ask the student pairs to each select one rectangular area as their new design for the Kindergarten enclosure. Have students share their selection with the whole class, justifying their choice.

Note to Teacher: Students should share their solution in a personally relevant manner. This may include highlighting their preferred rectangular design by using overhead transparencies, computer software or by referring to diagrams or manipulative representations they have created.

Circulate to observe and interact with students. Focus on the types of manipulatives students are choosing and how efficiently students are organizing data. Prompt them to look for patterns in their data. Ask:

- What do you notice about the area of your rectangles as the length of the sides changes?

Teacher Note: A square is a special type of rectangle.

Checking student progress

Teacher Note: Based on the observations you are making as you circulate and interact with your students, this may be an ideal time to bring students together to reflect on work in progress. Students will be at various points in determining the relationship that exists between area and perimeter. Engaging in math talk at this time will allow students to clarify their thinking and to reflect on the work of others.

If groups have difficulty organizing their data and seeing relationships between perimeter and area, you may facilitate their learning by using strategies that promote talk and the sharing of ideas. Whole-group strategies for sharing might include “Gallery Walk” or “One Stay One Stray”.

Prompt: That’s an interesting observation. I wonder if that relationship is present in anyone else’s data?

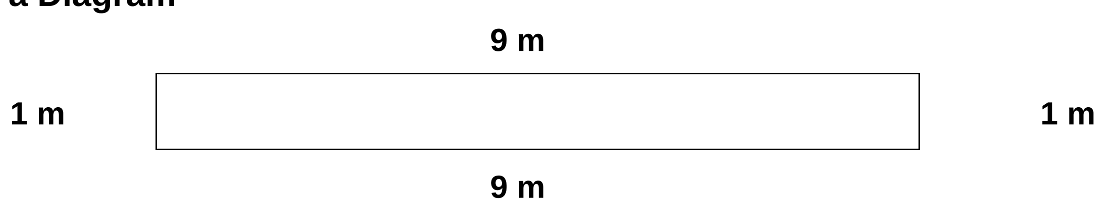
Alternatively, you may choose to invite particular students to visit another group. Some students might benefit from guided instruction and support.
If groups continue to have difficulty organizing their data, provide them with **M.BLM4b.1**, which will allow students to transfer the information they have generated to an organized format in order to focus on patterns and relationships.

Strategies Students Might Use

Create a Table of Values

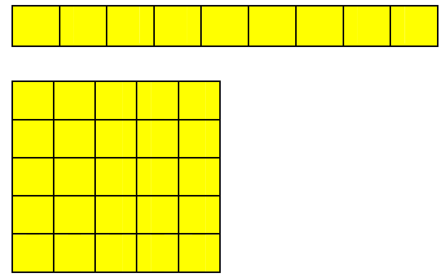
Length of Side One	Length of Side Two	Length of Side Three	Length of Side Four	Perimeter	Area
4 m	6 m	6 m	4 m	20 m	24 m^2
9 m	1 m	1 m	9 m	20 m	9 m^2
5 m	5 m	5 m	5 m	20 m	25 m^2

Draw a Diagram



Model Using Concrete Materials

Have a variety of commercial and non-commercial manipulatives available for students to choose from. Manipulatives may include, but need not be restricted to, the following: square sticky notes, coloured tiles, geoboards, grid paper, dot paper, cubes.



Use Numerical Representation

4 m + 6 m + 4 m + 6 m = 20 m

5 m + 5 m + 5 m + 5 m = 20 m

$6 m^2 + 6 m^2 + 6 m^2 + 6 m^2 = 24 m^2$

$5 m^2 + 5 m^2 + 5 m^2 + 5 m^2 + 5 m^2 = 25 m^2$

Reflecting and Connecting

Have pairs or small groups of students share their choices and justify their solution by discussing how the Kindergarten play enclosure they have designed provides the most effective space and meets the needs of Kindergarten students.

Ask students to clarify their understanding of the relationship between perimeter and area, by responding to questions such as:

- How did the relationship between perimeter and area affect your decision?
- What strategies did you use to help develop your understanding of this relationship?
- What strategies did you see/hear others using? Which strategies seemed to be most effective?

Draw students' attention to the different formats used to record solutions. Ask questions such as:

- In what different ways did pairs or groups record their strategies and solutions?
- Which forms are easy to understand?

Tiered Instruction

Supports and extensions can be beneficial for all students. For any given activity, there will always be some students who require more or less support, or for whom extensions will increase interest and deepen understanding.

Supports for student learning

- Some students may benefit from prompts that encourage them to think about which manipulatives and tools will help them to arrive at a solution and organize their work in a manner that can be clearly communicated.
- For students who experience difficulty, simplify the problem by providing an organized list of dimensions for some of the possible rectangles with a given perimeter. While there is great value in having students record their learning in personally relevant ways, **M.BLM4b.1** may be made available to those students requiring further support in organizing their data.

Extensions

Tangram Teasers. Provide each student with a set of tangrams and several sheets of grid paper. Challenge students to find the configuration of the 7 tangram pieces having: the shortest perimeter; the longest perimeter. Using a cooperative learning strategy such as “Think/Pair/Share” or “Partner to Partner”, direct students to justify their thinking by discussing the following question: Is it possible to order our drawings by size of area?

Literature Link: *Grandfather Tang’s Story*, by Ann Tompert. Published by Dragonfly Books. ISBN 0517885581

Teacher Note: In this task, area will remain constant as perimeter changes. Students may not yet realize this fact. Challenge them to verify their conjectures by measuring.

Perplexing Pentomino Perimeter. Pentominoes are made by joining five squares so that each square shares at least one edge with another. Challenge students to find and create on grid paper all possible pentominoes. Students can then use these templates to create a personal set of pentomino manipulatives. Have them record the perimeter for each pentomino piece. Ask: Which pentominoes have a greater area? (All have the same area.) Which pentominoes have the greatest/least perimeter? What is the smallest/greatest perimeter possible when joining two pentominoes?

Home Connections

Measuring Tables at Home

In our homes we use table surfaces for various purposes. We use rectangular countertops in the kitchen for food preparation; we may have smaller rectangular tables near chairs in our living rooms. The perimeter and area of table surfaces is often determined by function and by the available space in our homes. Measure the perimeter and calculate the area of some of the table surfaces in your home and note how the size and shape of the table makes it well suited for particular uses. Based on your investigation, identify an ideal table surface for homework completion, and provide reasons for your choice.

Assessment

Ongoing assessment opportunities are embedded throughout this activity. Use curriculum expectations to focus your observations and assess how effectively students:

- choose and apply personal benchmarks for one metre
- reflect on estimates and measurement strategies
- select and use measurement tools
- communicate and justify their findings regarding the best use of space
- express their understanding of the relationship between perimeter and area

Rubric

Assessment category	Level 1	Level 2	Level 3	Level 4
Knowledge and understanding				
– distinguishes between area and perimeter	☐ limited	☐ some	☐ considerable	☐ thorough
– identifies relationships among units and measurable attributes	☐ limited	☐ some	☐ considerable	☐ thorough
– compares shapes that have same perimeter or same area	☐ limited	☐ some	☐ considerable	☐ thorough
– describes relationship between perimeter and rectangular area	☐ limited	☐ some	☐ considerable	☐ thorough
– constructs tables, graphs, and diagrams to represent data	☐ limited	☐ some	☐ considerable	☐ thorough
Thinking				
– creates plan of action for exploring measurement relationships	☐ limited	☐ some	☐ considerable	☐ high degree
– identifies and uses patterns in problem solving	☐ limited	☐ some	☐ considerable	☐ high degree
– makes predictions for pattern growth in area and perimeter	☐ limited	☐ some	☐ considerable	☐ high degree
– explores alternative solutions	☐ limited	☐ some	☐ considerable	☐ high degree
Communication				
– explains mathematical thinking	☐ limited	☐ some	☐ considerable	☐ high degree
– communicates using a variety of modes (short answers, lengthy explanations, verbal and written reports)	☐ limited	☐ some	☐ considerable	☐ high degree
– uses appropriate vocabulary and terminology	☐ limited	☐ some	☐ considerable	☐ high degree
Application				
– applies measurement skills in familiar contexts	☐ limited	☐ some	☐ considerable	☐ high degree
– transfers knowledge and skills to new contexts	☐ limited	☐ some	☐ considerable	☐ high degree
– makes connections among concepts	☐ limited	☐ some	☐ considerable	☐ high degree

M.BLM4b.1: Recording Chart

Length of Side One	Length of Side Two	Length of Side Three	Length of Side Four	Perimeter	Area